FLUOR DANIEL GTI

10095639

ENGINEERING REPORT
GEOTECHNICAL EXPLORATION PROGRAM
SOUTH CAROLINA AQUARIUM PARKING GARAGE
CALHOUN PARK AREA SITE
CHARLESTON, SOUTH CAROLINA

Prepared for:
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October 1997

Fluor Daniel GTI Project 01003-0790

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1.0 INTRODUCTION

This Engineering Report has been prepared by Fluor Daniel GTI, Inc. (Fluor Daniel GTI) to present the findings of the Geotechnical Exploration Program (GEP). The GEP was implemented to gain necessary information for construction of the City of Charleston parking garage on a portion of the Calhoun Park Area Site (CPA Site) in the City of Charleston, South Carolina. Fluor Daniel GTI provided an on-site geologist to manage drilling activities conducted by R. Simmons Drilling, Inc. and performed oversite of the geotechnical evaluation performed by SM&E, Inc. The on-site field work was conducted between August 12 through August 23, 1997.

The purpose of this engineering report is to document the performance of the GEP, to demonstrate that the GEP was conducted in accordance with the approved Work Plan prepared by Fluor Daniel GTI, dated June 1997, and present the findings of the geotechnical exploration.

The following sections of this report summarize the background information and the GEP objectives, document the field work which was performed, and present the geotechnical findings.

1.1 Site Background and Setting

The CPA Site encompasses approximately 18 acres on the eastern side of the Charleston Peninsula and is bordered to the north by Charlotte Street, to the west by Washington Street, to the south by Laurens Street, and to the east by Concord Street. The CPA Site is comprised of three main sections: SCE&G's Charlotte Street electrical substation; Calhoun Park; and the former Ansonborough Homes public housing complex. The CPA site is bisected by Calhoun Street which separates the northern portion of the site, comprised of the SCE&G substation and Calhoun Park, from the southern portion of the site, comprised of the former Ansonborough housing complex. The Cooper River is located approximately 500 feet east of the CPA Site.

This GEP focused on the Calhoun Park portion of the CPA Site, which is currently owned by the City of Charleston. Calhoun Park was formerly a public recreational park before it was closed and fenced off in June 1989. Calhoun Park currently includes a former ballfield and concrete surfaced basketball court and an abandoned picnic shelter. Prior to use as a park, the Calhoun Park portion of the CPA Site was used for industrial purposes. In the late 1800's, this area was occupied by the Fernoline Chemical Company and is located adjacent to a former manufactured gas plant (MGP) which operated from the 1850's to the 1950's (RI Report, Fluor Daniel GTI, 1996).

Current plans for the Calhoun Park portion of the CPA Site include the construction of a parking garage to support the parking requirements of the South Carolina Aquarium being constructed on the NPS property and other urban redevelopment projects in the immediate vicinity (FS Report, Fluor Daniel GTI, 1997). The proposed parking garage will consist of a six-level reinforced concrete structure with a

footprint of 180 feet by 365 feet, and is expected to have capacity of approximately 1,100 automobiles. The construction of this structure will require adequate subsurface support. Based on preliminary design information, the column loads for the structure are expected to be in the range of 500 to 1,200 kips. It is anticipated that the elevation of the first garage level will be near present grade.

1.2 Objectives

The purpose of implementing the GEP was to conduct a subsurface investigation to obtain specific geotechnical information from the Calhoun Park property necessary for the design of the parking garage. This geotechnical information was collected during the installation of six (6) borings to a total depth of approximately 77 to 97 feet which were terminated within the Cooper Marl. The specific objectives of this exploration program included:

- The determination of site subsurface conditions and their relationship to load bearing capacity requirements;
- Evaluation of site conditions relative to site preparation; and
- The evaluation of potential foundation design constraints which could potentially effect the construction of the parking garage.

In addition to these geotechnical concerns, the on-site field work was conducted at the CPA Site to satisfy the following environmental concerns:

- The handling of waste material generated from the field activities as investigation derived waste (IDW) and its proper management in accordance with the EPA approved Sampling and Analysis Plan (SAP) (RI/FS Work Plan, Chester, 1993); and
- Completion of intrusive drilling activities during penetration of the upper clay layer and intermediate clay layer in a manner that would not permit groundwater in the upper water-bearing units to contact groundwater in the lower water-bearing units.

The remainder of this Engineering Report discusses how the project objectives were fulfilled while addressing the above environmental concerns.

2.0 FIELD WORK

Fluor Daniel GTI provided an on-site geologist to manage drilling activities conducted by R. Simmons Drilling, Inc. and performed oversite of the geotechnical evaluation performed by SM&E, Inc. The on-site field work was conducted between August 12 through August 23, 1997. Additionally, Mr. Charles Till, US EPA Region IV, performed oversite during implementation of the project from August 12 through August 15, 1997.

2.1 Health and Safety

All field work was conducted in accordance with the site-specific Health and Safety Plan (HASP) submitted as part of the RI/FS Work Plan for the CPA Site (RI/FS Work Plan, Chester, 1993). This plan addressed drilling activities, sampling activities, and waste handling activities. All work was performed by personnel having OSHA 1910 training. A Fluor Daniel GTI representative was present on-site during all drilling activities to ensure that the HASP was followed and that appropriate Fluor Daniel GTI health and safety protocols were implemented. Copies of the Daily Tailgate Meeting Logs are presented in Appendix A.

2.2 Field Drilling and Sampling Activities

Sub-surface conditions, examined during implementation of the GEP, were explored by drilling seven (7) geotechnical exploration test borings (GT-1 through GT-6, and GT-1A) within the footprint of the proposed parking garage structure. Approximate locations of the borings completed at the site are shown on Figure 1 (Boring Location Plan). Boring GT-1 was terminated at 12 feet below ground surface (bgs) due to obstructions. However, the other six (6) borings were drilled to depths ranging from 77 to 97 feet, assuring adequate penetration into the Cooper Formation (locally known as "the marl"). Drilling logs for the borings are presented in Appendix B.

Due to suspected constituent impacts in the shallow water-bearing unit, an outer 8-inch surface casing was installed at each of the six (6) boring locations in the upper clay unit to eliminate the potential for migration of the shallow groundwater to lower water-bearing zones. The casing depth varied from 15 feet (5 borings) to 19 feet (1 boring). The casings were then grouted and allowed to cure for at least 24 hours. The borings were then advanced further and a 4-inch inner surface casing was telescoped through the 8-inch casing. These casings were also installed to isolate groundwater and varied between 57 and 63 feet in depth. The casings were also grouted and allowed to cure for at least 24 hours before the borings were advanced to their termination depth within the Cooper Formation.

Standard Penetration Tests (ASTM DD-1856) and split spoon samples were obtained continuously in the upper 8 to 10-feet of the borings (except GT-2 which was continuously sampled to 16-feet) and at 5-foot intervals thereafter. Field logs of the daily drilling procedures are provided in Appendix C.

2.3 Decontamination Procedures

Appropriate decontamination procedures were followed during drilling activities, as specified in the Sampling and Analysis Plan (SAP) (RI/FS Work Plan, Chester, 1993). Since no samples were collected for analyses of chemical constituents, an abbreviated decontamination procedure was utilized. The following procedures were used for field decontamination of non-dedicated equipment that came into direct contact with the geotechnical samples.

Gross material was removed from the sampling equipment by brushing and rinsing with tap water. Sampling equipment was then washed with non-phosphate detergent (Alconox) and potable water and rinsed with distilled water. The drill rig was decontaminated prior to and after drilling activities.

2.4 Material Handling Procedures

The IDW from the drilling activities was containerized in D.O.T. approved drums. The material generated was visually inspected and screened for volatile organic compounds (VOCs) using a photoionization detection (PID) and classified as it was generated. Additionally, the settled mud slurry, generated during the rotary mud drilling of the deep borings, was inspected and screened in the same manner. The drums containing IDW were labeled, staged on-site, and covered. Final disposition of these drums will be finalized upon determination of guidelines related to the currently pending on-site removal action.

2.5 Site Restoration

After each boring was completed to its total depth, the boring was grouted using a Portland cement/bentonite slurry mixture. The slurry was pumped to the bottom of the boring via a tremmie pipe placed to discharge at the base of the boring. The grout was pumped until all drilling fluid were displaced into the in-place mud pan and the grout returns were observed at the surface. Following placement of the grout, drilling mud was pumped to D.O.T. drums and the mud pan removed. The boring casings were cut off below-grade and the locations were marked with stakes for subsequent surveying.

3.0 GEOTECHNICAL FINDINGS

The subsurface exploration and geotechnical analyses was performed under the direction of Fluor Daniel GTI by SM&E, Inc. in accordance with the preliminary design criteria for the parking garage and appropriate ASTM requirements. The geotechnical findings presented in this report are based on the completion of the soil test borings to depths ranging from 12 to 97-feet bgs.

The analyses and recommendations presented in this report are based, in part, upon the data obtained from the subsurface investigation. The nature and extent of variations between the borings will not become evident until actual construction activities begin. If variations appear evident, the recommendations set forth in this report may require re-evaluation.

Since the Charleston area is within a known seismically active region, earthquake loads are an important part of the design process. Seismic considerations, including the evaluation of a seismic site coefficient, liquefaction analysis, and liquefaction potential, have been performed for the CPA Site during the geotechnical exploration. Based on these considerations, the construction of a deep foundation system bearing in the Cooper Marl is recommended. Additional recommendations and conclusions are presented in the following section.

3.1 Summary of Recommendations and Conclusions

A brief summary of conclusions and recommendations resulting from the completion of the geotechnical exploration is presented below.

- The borings encountered a variety of sand and clay soil strata that varied in consistency and thickness. Four (4) strata are of particular importance were identified and confirmed. These are:

  1) From ground surface, a 6 to 10 feet layer of uncontrolled fill (sand with bricks, concrete, wood, etc.,) was encountered. The fill characteristics are consistent with previous investigations conducted in the area of Calhoun Park. At boring location GT-1, there was also subsurface debris present, which prevented drilling;

  2) Beneath the fill, a thick (typically 35 feet) very soft, highly plasticity clay was encountered. This layer was present at all boring locations and was used to set the upper casings, since this layer is of lower permeability and retards vertical migration of groundwater;

  3) Below the upper clay, a sand unit was encountered, generally at a depth of 40 to 45 feet bgs. The unit was present at all deep boring locations; and

  4) The final stratum encountered was the Cooper Marl, a soft to hard sandy silt, which was encountered at approximately 80 feet below grade. Borings were advanced into this material at depths ranging from 77 to 97 feet bgs.

- Based on the soil type S_3 encountered during the exploration, a seismic site coefficient (S) of 1.5 is recommended for seismic design. Sand deposits within the fill (upper 6 to 10-feet) and between 45 and 55 feet at the site may liquefy during a seismic event.

- A deep foundation system will be required to support the proposed structure. A foundation system consisting of driven piles (12-inch and 14-inch square prestressed concrete piles and H-piles) was the only option considered.

- The first floor slab, if earth supported without ground modification, may settle 6-inches or more due to the placement of 2-feet of new conventional fill at the site. Options that may be considered to eliminate this settlement include:

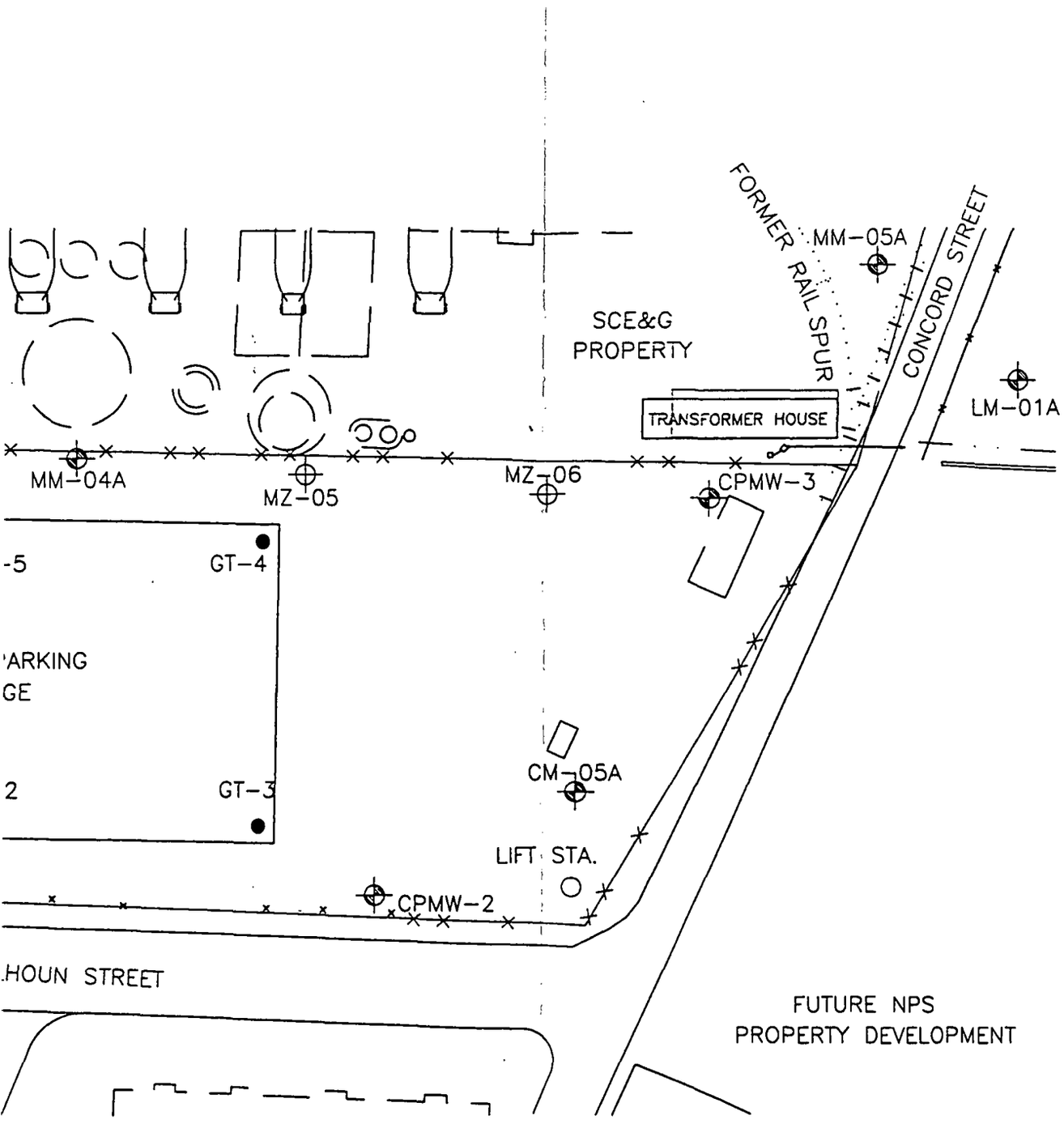
  1) Structural tie-in of the slab to the piling;

  2) Filling of the site with a lightweight fill (or a combination of lightweight and conventional fill) to reduce the load induced by the fill; and

  3) Surcharging of the site using flexible asphalt paving in the first floor area with anticipation of future repairs to the asphalt surface due to settlement. Alternatively, a ground modification program could be used to reduce post construction settlement.

A detailed presentation of this summary, which is inclusive of seismic considerations, foundation requirements, soil data, laboratory testing procedures, and consolidation reports, is presented in the *Report of Geotechnical Exploration*, prepared by SM&E, Inc. and is located in Appendix D of this document.

FIGURES



LEGEND

- SHALLOW PIEZOMETER LOCATION
- SHALLOW MONITORING WELL LOCATION
- INTERMEDIATE MONITORING WELL LOCATION
- DEEP MONITORING WELL LOCATION
- BORING LOCATION
- FORMER STRUCTURES

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SCALE FEET

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EAST PITTSBURGH, PA 15112
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FAX: (412) 824-7215

REV. NO.:	DRAWING DATE: 6/09/97	ACAD FILE: 97079024.DWG

BORING LOCATIONS PLANS

CLIENT:	PM:
THE KEENAN COMPANY	G.G.

APPENDIX A
DAILY TAILGATE MEETING LOGS

TAILGATE MEETING FORM

Project Name: SCE&G

Date: 8/12/97

Project Number: 010030780

Presented by: EDWIN FOX

Check the Topics/Information Reviewed:

- ☑ safety glasses, hard hat, safety boots
- ☑ site safety plan review and location
- ☐ equipment and machinery familiarization
- ☑ employee Right-To-Know/MSDS location
- ☐ open pits, excavations, and site hazards
- ☐ vehicle safety and driving/road conditions
- ☐ portable tool safety and awareness
- ☑ overhead utility locations and clearance
- ☑ first aid, safety, and PPE location
- ☐ sharp object, rebar, and scrap metal hazards
- ☑ safety is everyone's responsibility
- ☑ latex gloves inner/nitrile gloves outer
- ☐ excavation/trenching inspections/documentation
- ☐ full face respirators with proper cartridges
- ☐ upgrade to level c at: FID/PID (___ eV) >___ ppm
- ☐ work stoppage at: FID/PID(___ eV) >___ ppm, % LEL > 10%
- ☐ slips, trips, and falls
- ☑ directions to hospital
- ☑ anticipated visitors
- ☐ electrical ground fault
- ☐ public safety and fences
- ☐ excavator swing and loading
- ☐ orderly site and housekeeping
- ☑ smoking in designated areas
- ☑ leather gloves for protection
- ☐ effects of the night before
- ☑ vibration related injuries
- ☑ fire extinguisher locations
- ☐ eye wash station locations
- ☑ decontamination procedures
- ☑ daily work scope
- ☐ emergency protocol
- ☐ parking and laydown
- ☐ hot work permits
- ☐ strains and sprains
- ☐ noise hazards
- ☐ no horseplay
- ☑ heat and cold stress
- ☐ backing up hazards
- ☐ accidents are costly
- ☐ dust and vapor control
- ☐ refueling procedures
- ☐ confined space entry
- ☐ flying debris hazards

Discussion/Comments/Follow-up Actions:

NAME	SIGNATURE	COMPANY
Mike Armstrong	Mike Armstrong	R.S.D
John Stackrisk		RSO
Charles Lacko		R.S.D
Charles G. Tell	Charles G Tell	FEPA
EDWIN FOX	Edwin T Fox	FLUOR DANIEL GTI

Instructions:

- Conduct a daily safety meeting prior to beginning each day's site activities.
- Complete form by checking off specific topics and/or hazards.
- Obtain signatures from all GTI staff and GTI subcontractors.
- Follow-up on any noted items and document resolution of any action items.

TAILGATE MEETING FORM

Project Name: SCE+G GEOTECH Date: 8/13/97

Project Number: 016030290 Presented by: EDWIN FOX

Check the Topics/Information Reviewed:

- ☑ safety glasses, hard hat, safety boots
- ☐ site safety plan review and location
- ☐ equipment and machinery familiarization
- ☐ employee Right-To-Know/MSDS location
- ☐ open pits, excavations, and site hazards
- ☐ vehicle safety and driving/road conditions
- ☐ portable tool safety and awareness
- ☐ overhead utility locations and clearance
- ☐ first aid, safety, and PPE location
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- ☐ upgrade to level c at: FID/PID (___ eV) >___ ppm
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  - ☐ accidents are costly
  - ☐ dust and vapor control
  - ☐ refueling procedures
- ☐ confined space entry
- ☐ flying debris hazards

Discussion/Comments/Follow-up Actions:

NAME	SIGNATURE	COMPANY
EDWIN FOX	Edwin T. Fox	FLUOR DANIEL GTI
Chris Lacko	Chris Lacko	K&D
Mike Armstrong	Mike Armstrong	R.S.D
Charles Till	Charles Till	FGH
John Stoddard	John Stoddard	R.S.D

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TAILGATE MEETING FORM

Project Name: SCE&G GEOTECH Date: 8/14/97

Project Number: 0100307.90 Presented by: EDWIN FOX

Check the Topics/Information Reviewed:

- ☒ safety glasses, hard hat, safety boots
- ☐ site safety plan review and location
- ☐ equipment and machinery familiarization
- ☐ employee Right-To-Know/MSDS location
- ☐ open pits, excavations, and site hazards
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- ☐ confined space entry
- ☐ flying debris hazards

Discussion/Comments/Follow-up Actions: PHOTOSENSITIVE NATURE OF COAL TAR

NAME	SIGNATURE	COMPANY
EDWIN FOX	Edwin T. Fox	FLUOR DANIEL GTT
Mike Armstrong	Mike Armstrong	R.S.D
John Slachciak		R.S.D
Chris Lacko		R.S.D
Charles Till		F&A

Instructions:

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- Complete form by checking off specific topics and/or hazards.
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TAILGATE MEETING FORM

Project Name: SEMG EXEC-TECH Date: 8/15/97

Project Number: 0100 30190 Presented by: EDWIN FOX

Check the Topics/Information Reviewed:

- ☑ safety glasses, hard hat, safety boots
- ☐ site safety plan review and location
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- ☐ flying debris hazards

Discussion/Comments/Follow-up Actions:

NAME	SIGNATURE	COMPANY
EDWIN FOX	Edwin T. Fox	FLUOR DANIEL GTI
Mike Armstrong	Mike Armstrong	R.S.D
Chris Cacko	Chris Cacko	R.S.D.
John Stachelek	John Stachelek	RSD
Charles Till	Charles Till	EPA

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TAILGATE MEETING FORM

Project Name: SCFAC Date: 8/16/97

Project Number: 01003079.0 Presented by: EDWIN FOX

Check the Topics/Information Reviewed:

- ☑ safety glasses, hard hat, safety boots
- ☑ site safety plan review and location
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Discussion/Comments/Follow-up Actions: _____

NAME	SIGNATURE	COMPANY
EDWIN FOX	Edwin T. Fox	FLUOR DANIEL GTI
Mike Armstrong	Mike Armstrong	R.S.D
Chris Lacko	Chris Lacko	R.S.D.
GALE DAUS	Gale Daus	R.S.D.

Instructions:

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TAILGATE MEETING FORM

Project Name: SCTG Date: 8/12/97

Project Number: 01603 0790 Presented by: EDWIN FOX

Check the Topics/Information Reviewed:

- ☑ safety glasses, hard hat, safety boots
- ☐ site safety plan review and location
- ☐ equipment and machinery familiarization
- ☐ employee Right-To-Know/MSDS location
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- ☐ confined space entry
- ☐ flying debris hazards

Discussion/Comments/Follow-up Actions:

NAME	SIGNATURE	COMPANY
EDWIN FOX	Edwin T. Fox	FLUOR DANIEL GTI
Mike Armstrong	Mike Armstrong	R.S.D
Chris Layko	Chris Layko	R.S.D
Gale Davis	Gale Davis	R.S.P

Instructions:

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- Complete form by checking off specific topics and/or hazards.
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- Follow-up on any noted items and document resolution of any action items.

TAILGATE MEETING FORM

Project Name: CALHOUN PARK GEO-TECH Date: 8/18/97

Project Number: 010030790 Presented by: EDWIN FOX

Check the Topics/Information Reviewed:

- ☑ safety glasses, hard hat, safety boots
- ☐ site safety plan review and location
- ☐ equipment and machinery familiarization
- ☐ employee Right-To-Know/MSDS location
- ☐ open pits, excavations, and site hazards
- ☐ vehicle safety and driving/road conditions
- ☐ portable tool safety and awareness
- ☐ overhead utility locations and clearance
- ☐ first aid, safety, and PPE location
- ☐ sharp object, rebar, and scrap metal hazards
- ☑ safety is everyone's responsibility
- ☐ latex gloves inner/nitrile gloves outer
- ☐ excavation/trenching inspections/documentation
- ☐ full face respirators with proper cartridges
- ☐ upgrade to level c at: FID/PID (___ eV) >___ ppm
- ☐ work stoppage at: FID/PID(___ eV) >___ ppm, % LEL > 10%
- ☐ slips, trips, and falls
- ☐ directions to hospital
- ☐ anticipated visitors
- ☐ electrical ground fault
- ☐ public safety and fences
- ☐ excavator swing and loading
- ☐ orderly site and housekeeping
- ☑ smoking in designated areas
- ☐ leather gloves for protection
- ☐ effects of the night before
- ☐ vibration related injuries
- ☐ fire extinguisher locations
- ☐ eye wash station locations
- ☐ decontamination procedures
- ☐ daily work scope
- ☐ emergency protocol
- ☐ parking and laydown
- ☐ hot work permits
- ☐ strains and sprains
- ☐ noise hazards
  - ☐ no horseplay
  - ☐ heat and cold stress
- ☐ backing up hazards
  - ☐ accidents are costly
  - ☐ dust and vapor control
  - ☐ refueling procedures
- ☐ confined space entry
- ☐ flying debris hazards

Discussion/Comments/Follow-up Actions:

NAME	SIGNATURE	COMPANY
EDWIN FOX	Edwin T. Fox	FLUOR DANIEL GTI
Chris Lacko	Chris Lacko	R.S.D.
Mike Armstrong	Mike Armstrong	R.S.D.
GAIE DAVIS	Gaie Davis	R.S.D.

Instructions:

- Conduct a daily safety meeting prior to beginning each day's site activities
- Complete form by checking off specific topics and/or hazards.
- Obtain signatures from all GTI staff and GTI subcontractors.
- Follow-up on any noted items and document resolution of any action items.

TAILGATE MEETING FORM

Project Name: SCE&G GEOTECH Date: 8/19/97

Project Number: 01003-0790 Presented by: EDWIN FOX

Check the Topics/Information Reviewed:

- ☑ safety glasses, hard hat, safety boots
- ☐ site safety plan review and location
- ☐ equipment and machinery familiarization
- ☐ employee Right-To-Know/MSDS location
- ☐ open pits, excavations, and site hazards
- ☐ vehicle safety and driving/road conditions
- ☐ portable tool safety and awareness
- ☐ overhead utility locations and clearance
- ☐ first aid, safety, and PPE location
- ☐ sharp object, rebar, and scrap metal hazards
- ☐ safety is everyone's responsibility
- ☑ latex gloves inner/nitrile gloves outer
- ☐ excavation/trenching inspections/documentation
- ☐ full face respirators with proper cartridges
- ☐ upgrade to level c at: FID/PID (___ eV) >___ ppm
- ☐ work stoppage at: FID/PID(___eV) >___ ppm, % LEL > 10%
- ☐ slips, trips, and falls
- ☐ directions to hospital
- ☐ anticipated visitors
- ☐ electrical ground fault
- ☐ public safety and fences
- ☐ excavator swing and loading
- ☐ orderly site and housekeeping
- ☐ smoking in designated areas
- ☐ leather gloves for protection
- ☐ effects of the night before
- ☐ vibration related injuries
- ☑ fire extinguisher locations
- ☐ eye wash station locations
- ☐ decontamination procedures
- ☐ daily work scope
- ☐ emergency protocol
- ☐ parking and laydown
- ☐ hot work permits
- ☐ strains and sprains
- ☐ noise hazards
- ☐ no horseplay
- ☑ heat and cold stress
- ☐ backing up hazards
- ☐ accidents are costly
- ☐ dust and vapor control
- ☐ refueling procedures
- ☐ confined space entry
- ☐ flying debris hazards

Discussion/Comments/Follow-up Actions:

NAME	SIGNATURE	COMPANY
EDWIN FOX	Edwin Fox	FLUOR DANIEL GTI
Mike Armstrong	Mike Armstrong	R.S.D.C.T.
Chris Lacko	Chris Lacko	R.S.D.
GALE DAVIS	Gale Davis	R.S.D.

Instructions:

- Conduct a daily safety meeting prior to beginning each day's site activities
- Complete form by checking off specific topics and/or hazards.
- Obtain signatures from all GTI staff and GTI subcontractors.
- Follow-up on any noted items and document resolution of any action items

TAILGATE MEETING FORM

Project Name: SCE+G

Date: 8/20/97

Project Number: 010038790

Presented by: E. Fox

Check the Topics/Information Reviewed:

- ☑ safety glasses, hard hat, safety boots
- ☐ site safety plan review and location
- ☐ equipment and machinery familiarization
- ☐ employee Right-To-Know/MSDS location
- ☐ open pits, excavations, and site hazards
- ☐ vehicle safety and driving/road conditions
- ☐ portable tool safety and awareness
- ☐ overhead utility locations and clearance
- ☐ first aid, safety, and PPE location
- ☐ sharp object, rebar, and scrap metal hazards
- ☑ safety is everyone's responsibility
- ☐ latex gloves inner/nitrile gloves outer
- ☐ excavation/trenching inspections/documentation
- ☐ full face respirators with proper cartridges
- ☐ upgrade to level c at: FID/PID (___ eV) >___ ppm
- ☐ work stoppage at: FID/PID(___ eV) >___ ppm, % LEL > 10%
- ☐ slips, trips, and falls
- ☐ directions to hospital
- ☐ anticipated visitors
- ☐ electrical ground fault
- ☐ public safety and fences
- ☐ excavator swing and loading
- ☐ orderly site and housekeeping
- ☐ smoking in designated areas
- ☐ leather gloves for protection
- ☐ effects of the night before
- ☐ vibration related injuries
- ☐ fire extinguisher locations
- ☐ eye wash station locations
- ☐ decontamination procedures
- ☐ daily work scope
- ☐ emergency protocol
- ☐ parking and laydown
- ☐ hot work permits
- ☐ strains and sprains
- ☐ noise hazards
- ☐ no horseplay
- ☑ heat and cold stress
- ☐ backing up hazards
- ☐ accidents are costly
- ☐ dust and vapor control
- ☐ refueling procedures
- ☐ confined space entry
- ☐ flying debris hazards

Discussion/Comments/Follow-up Actions:

NAME	SIGNATURE	COMPANY
EDWIN FOX	Edwin T. Fox	FLUOR DANIEL GTI
Mike Armstrong	Mike Armstrong	R.S.D.
Chris Lacko	Chris Lacko	R.S.D.
BAIE DAVIS	Baie Davis	R.S.D.

Instructions:

- Conduct a daily safety meeting prior to beginning each day's site activities.
- Complete form by checking off specific topics and/or hazards.
- Obtain signatures from all GTI staff and GTI subcontractors.
- Follow-up on any noted items and document resolution of any action items.

TAILGATE MEETING FORM

Project Name: SETH

Date: 8/21/97

Project Number: 010030790

Presented by: EDWIN FOX

Check the Topics/Information Reviewed:

- ☑ safety glasses, hard hat, safety boots
- ☐ site safety plan review and location
- ☐ equipment and machinery familiarization
- ☐ employee Right-To-Know/MSDS location
- ☐ open pits, excavations, and site hazards
- ☐ vehicle safety and driving/road conditions
- ☐ portable tool safety and awareness
- ☐ overhead utility locations and clearance
- ☐ first aid, safety, and PPE location
- ☐ sharp object, rebar, and scrap metal hazards
- ☑ safety is everyone's responsibility
- ☑ latex gloves inner/nitrile gloves outer
- ☐ excavation/trenching inspections/documentation
- ☐ full face respirators with proper cartridges
- ☐ upgrade to level c at: FID/PID (___ eV) >___ ppm
- ☐ work stoppage at: FID/PID(___ eV) >___ ppm, % LEL > 10%
- ☐ slips, trips, and falls
- ☐ directions to hospital
- ☐ anticipated visitors
- ☐ electrical ground fault
- ☐ public safety and fences
- ☐ excavator swing and loading
- ☐ orderly site and housekeeping
- ☐ smoking in designated areas
- ☐ leather gloves for protection
- ☐ effects of the night before
- ☐ vibration related injuries
- ☐ fire extinguisher locations
- ☐ eye wash station locations
- ☐ decontamination procedures
- ☑ daily work scope
- ☐ emergency protocol
- ☐ parking and laydown
- ☐ hot work permits
- ☐ strains and sprains
- ☐ noise hazards
- ☐ no horseplay
- ☑ heat and cold stress
- ☐ backing up hazards
- ☐ accidents are costly
- ☐ dust and vapor control
- ☐ refueling procedures
- ☐ confined space entry
- ☐ flying debris hazards

Discussion/Comments/Follow-up Actions:

NAME	SIGNATURE	COMPANY
EDWIN FOX	Edwin T. Fox	FLUOR DANIEL GTI
Mike Armstrong	Mike Armstrong	R.S.O
Chris Lacke	Chris Lacke	K.S.D
DAVE Mains	Dave Mains	R.S.D.

Instructions:

- Conduct a daily safety meeting prior to beginning each day's site activities
- Complete form by checking off specific topics and/or hazards.
- Obtain signatures from all GTI staff and GTI subcontractors.
- Follow-up on any noted items and document resolution of any action items.

TAILGATE MEETING FORM

Project Name: SCE&G GEO TECH Date: 8/22/97

Project Number: 01003079 Presented by: E. FOX

Check the Topics/Information Reviewed:

- ☐ safety glasses, hard hat, safety boots
- ☐ site safety plan review and location
- ☐ equipment and machinery familiarization
- ☐ employee Right-To-Know/MSDS location
- ☐ open pits, excavations, and site hazards
- ☐ vehicle safety and driving/road conditions
- ☐ portable tool safety and awareness
- ☐ overhead utility locations and clearance
- ☐ first aid, safety, and PPE location
- ☐ sharp object, rebar, and scrap metal hazards
- ☑ safety is everyone's responsibility
- ☑ latex gloves inner/nitrile gloves outer
- ☐ excavation/trenching inspections/documentation
- ☐ full face respirators with proper cartridges
- ☐ upgrade to level c at: FID/PID (___ eV) >___ ppm
- ☐ work stoppage at: FID/PID(___ eV) >___ ppm, % LEL > 10%
- ☐ slips, trips, and falls
- ☐ directions to hospital
- ☐ anticipated visitors
- ☐ electrical ground fault
- ☐ public safety and fences
- ☐ excavator swing and loading
- ☐ orderly site and housekeeping
- ☐ smoking in designated areas
- ☐ leather gloves for protection
- ☐ effects of the night before
- ☐ vibration related injuries
- ☐ fire extinguisher locations
- ☐ eye wash station locations
- ☐ decontamination procedures
- ☐ daily work scope
- ☐ emergency protocol
- ☐ parking and laydown
- ☐ hot work permits
- ☐ strains and sprains
- ☐ noise hazards
- ☐ no horseplay
- ☑ heat and cold stress
- ☐ backing up hazards
- ☐ accidents are costly
- ☐ dust and vapor control
- ☐ refueling procedures
- ☐ confined space entry
- ☐ flying debris hazards

Discussion/Comments/Follow-up Actions:

NAME	SIGNATURE	COMPANY
EDWIN FOX	Edwin T. Fox	FLUOR DANIEL GTI
Mike Armstrong	Mike Armstrong	R.S.D
CALE DAVIS	Cale Davis	R.S.D.

Instructions:

- Conduct a daily safety meeting prior to beginning each day's site activities
- Complete form by checking off specific topics and/or hazards.
- Obtain signatures from all GTI staff and GTI subcontractors.
- Follow-up on any noted items and document resolution of any action items.

APPENDIX B
DRILLING LOGS

Drilling Log

FLUOR DANIEL GTI

GT-01

Project Geotechnical Borings Owner City of Charleston, SC

Location Calhoun Park Proj. No. 010030790-02

Surface Elev. _____ Total Hole Depth 12 ft. Diameter 12 in.

Top of Casing _____ Water Level Initial 4 ft. Static _____

Screen: Dia _____ Length _____ Type/Size _____

Casing: Dia _____ Length _____ Type Sched. 40 PVC

Fill Material _____ Rig/Core GP-1000

Drill Co. R. Simmons Drilling Method Mud Rotary

Driller M. Armstrong Log By E. Fox Date 08/13/97 Permit # _____

Checked By C. Wingerd License No. _____

See Site Map For Boring Location

COMMENTS:

Depth (ft.)	Well Completion	PID (ppm)	Sample ID	Blow Count / % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
-2							
0			1	4 5 8 8			Moderate yellowish brown, medium dense, fine to medium SAND, some silt, moist.
2			2	5 10 7 8			Very dark gray, medium dense, silty, fine SAND some organic debris, moist.
4				8			Olive brown, medium dense, silty, fine SAND, saturated.
6			3	7 10 18			BRICK and WOOD fragments (FILL).
				10			Wood fragments.
8			4	12 15 28			BRICK and CONCRETE fragments (FILL), pinesol like odor.
			5	15 7 9 14			WOOD fragments (FILL).
10			6	13 10 12 13			WOOD fragments and CLAY (FILL).
12							Boring terminated and abandoned at 12 feet.
14							
16							
18							
20							
22							
24							

Drilling Log

FLUOR DANIEL GTI

GT-01A

Project *Geotechnical Borings* Owner *City of Charleston, South Carolina*

Location *Calhoun Park* Proj. No. *010030790-02*

Surface Elev. _____ Total Hole Depth *82 ft.* Diameter *12 in. to 4 in.*

Top of Casing _____ Water Level Initial *4 ft.* Static _____

Screen: Dia _____ Length _____ Type/Size _____

Casing: Dia *8 in. and 4 in.* Length *15 ft. and 58 ft.* Type *Schedule 40 PVC*

Fill Material _____ Rig/Core *GP-1000*

Drill Co. *R. Simmons Drilling* Method *Mud Rotary*

Driller *M. Armstrong* Log By *E. Fox* Date *08/20/97* Permit # _____

Checked By *C. Wingerd* License No. _____

See Site Map For Boring Location

COMMENTS:

Depth (ft.)	Well Completion	PID (ppm)	Sample ID	Blow Count / % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
-2							
0			1	4 5 6 10 10			Moderate yellowish brown, loose, fine to medium SAND, some silt, trace gravel, moist.
2			2	3 3 3			Brownish black, wood fragments, moist.
4			3	2 3 4 4 2			Light olive gray, loose, fine SAND, damp.
6			4	1 1 1			Brownish black, sandy peat, damp to moist.
8			5	WH			Gray, very loose, clayey, fine to coarse SAND and GRAVEL, saturated, slight pinesol-like odor.
10							Gray, very soft CLAY, wet.
12							
14							
16			8	WH			Dark greenish gray (5GY4/1), very soft CLAY, trace shell fragments, wet, H2S (rotton egg-like) odor.
18							
20			7	1/12" 1/12"			
22							
24							

Drilling Log

FLUOR DANIEL GTI

GT-01A

Project *Geotechnical Borings* Owner *City of Charleston, South Carolina*

Location *Calhoun Park* Proj. No. *010030790-02*

Depth (ft.)	Well Completion	PID (ppm)	Sample ID	Blow Count/ % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
24							No shell fragments, some organic debris at 25 feet.
26			8	WR			
28							
30			9	WR			
32							
34							
36			10	WR			
38							
40			11	2 3 2 4			Dark greenish gray (5GY4/1), very loose, fine SAND, some clay, saturated.
42							
44							
46			12	7 10 14 17			Medium gray, medium dense, fine to medium SAND, some fine gravel, trace coarse sand.
48							
50			13	3 4 6 7			Dark greenish gray (5GY4/1), medium stiff, fine SAND and CLAY. Dark greenish gray (5GY4/1), loose, clayey, fine SAND. Dark greenish gray (5GY4/1), medium stiff, CLAY and fine SAND, some shell fragments.
52							
54							
56			14	2 2			Dark greenish gray (5GY4/1), soft, silty CLAY, some sand and shell fragments, slightly plastic, wet.

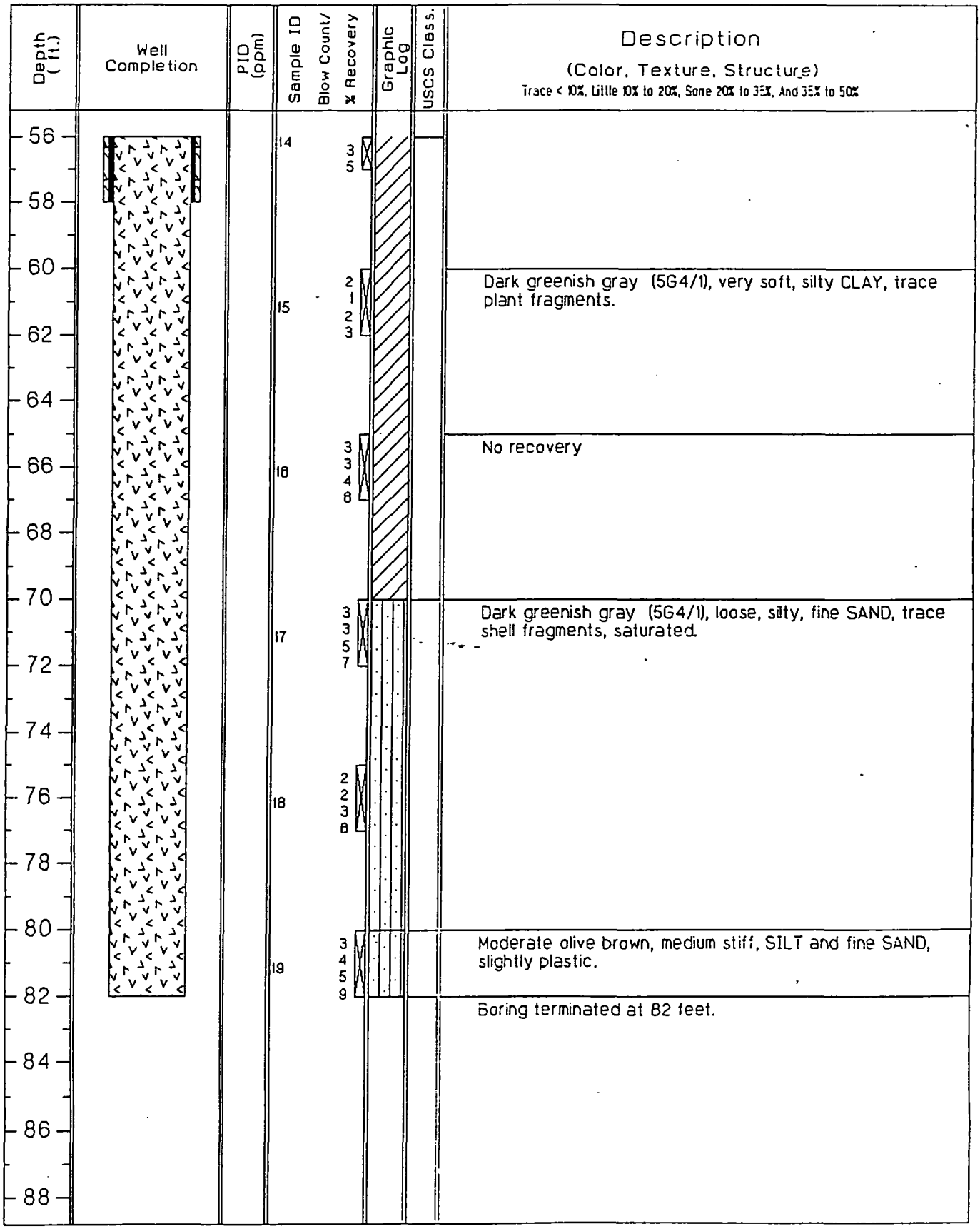
Drilling Log

FLUOR DANIEL GTI

GT-01A

Project *Geotechnical Borings* Owner *City of Charleston, South Carolina*

Location *Calhoun Park* Proj. No. *010030790-02*



Drilling Log

FLUOR DANIEL GTI

GT-02

Project Geotechnical Borings Owner City of Charleston, South Carolina

Location Calhoun Park Proj. No. 010030790-02

Surface Elev. ____ Total Hole Depth 97 ft. Diameter 12 in. to 4 in.

Top of Casing ____ Water Level Initial 2 ft. Static ____

Screen: Dia ____ Length ____ Type/Size ____

Casing: Dia 8 in. and 4 in. Length 19 ft. and 62 ft. Type Schedule 40 PVC

Fill Material ____ Rig/Core GP-1000

Drill Co. R. Simmons Drilling Method Mud Rotary

Driller M. Armstrong Log By E. Fox Date 08/12/97 Permit # ____

Checked By C. Wingerd License No. ____

See Site Map For Boring Location

COMMENTS:

Depth (ft.)	Well Completion	PID (ppm)	Sample ID	Blow Count/ % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
-2							
0			1				Moderate yellowish brown and dark olive gray, loose, fine to medium SAND, some silt and fine gravel, brick fragments, moist.
2			2	5 50/6"			Brownish black to dark grayish brown, loose, fine to medium SAND, some silt, saturated.
4			3	2 4 7 8			Wood in shoe. No Recovery, still getting wood in return water.
6			4	3 2 1 1			Dark yellowish brown, very loose, fine SAND, some silt. Olive black, sandy PEAT. Dark gray, very soft CLAY, some silt.
8			5	1/12"			
10			6	1/12" 1/12" 1/12"			
12			7	1/12"			
14			8	1/12" 1/12"			Shell fragments at 13.5 feet.
16							
18			9	1/24"			
20			10	WH			Dark greenish gray (5GY4/1), very soft, fine SAND and CLAY, some shell fragments, saturated, H2S (rotton egg-like) odor.
22							
24							

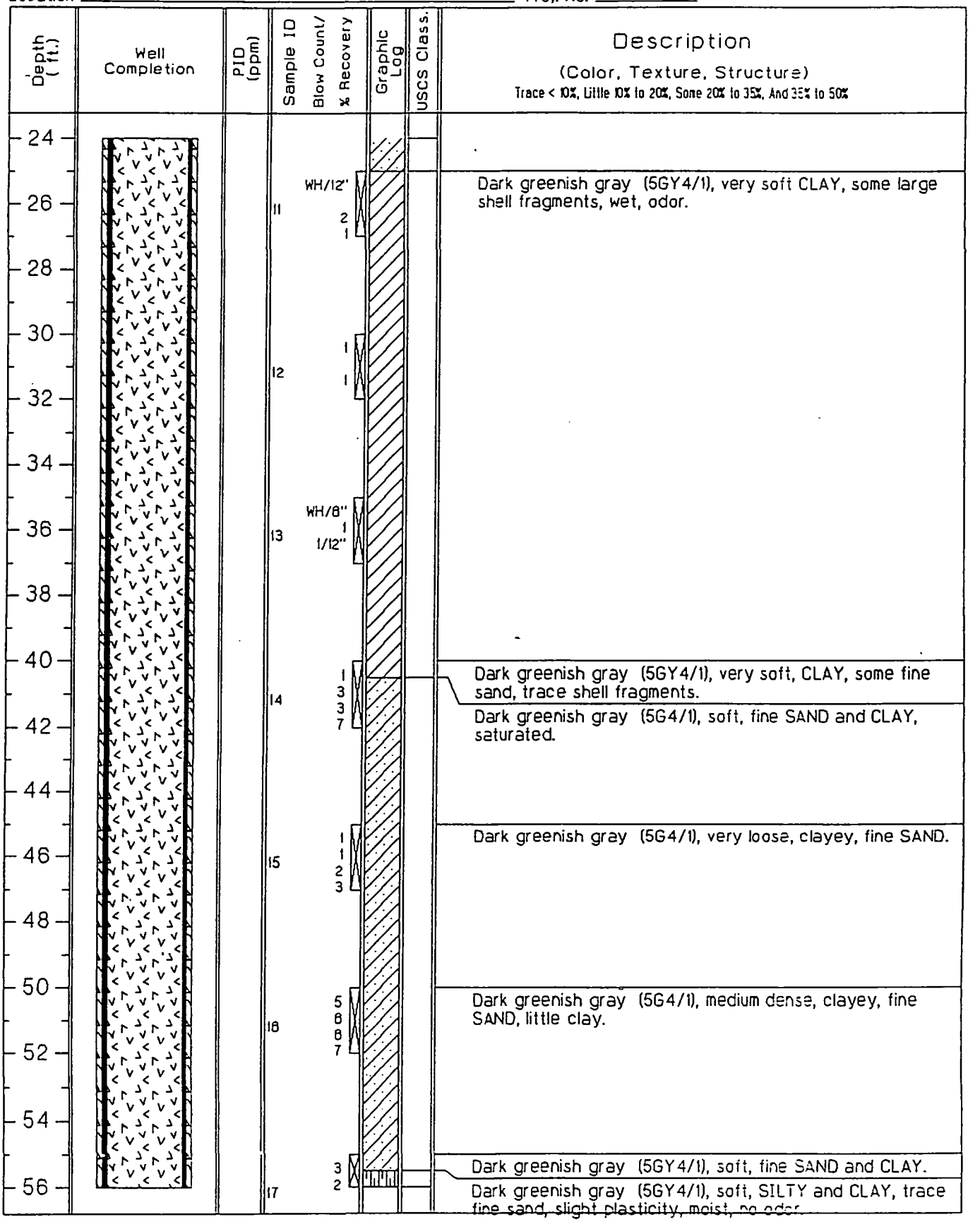
Drilling Log

FLUOR DANIEL GTI

GT-02

Project *GeotTechnical Borings* Owner *City of Charleston, South Carolina*

Location *Calhoun Park* Proj. No. *010030790-02*



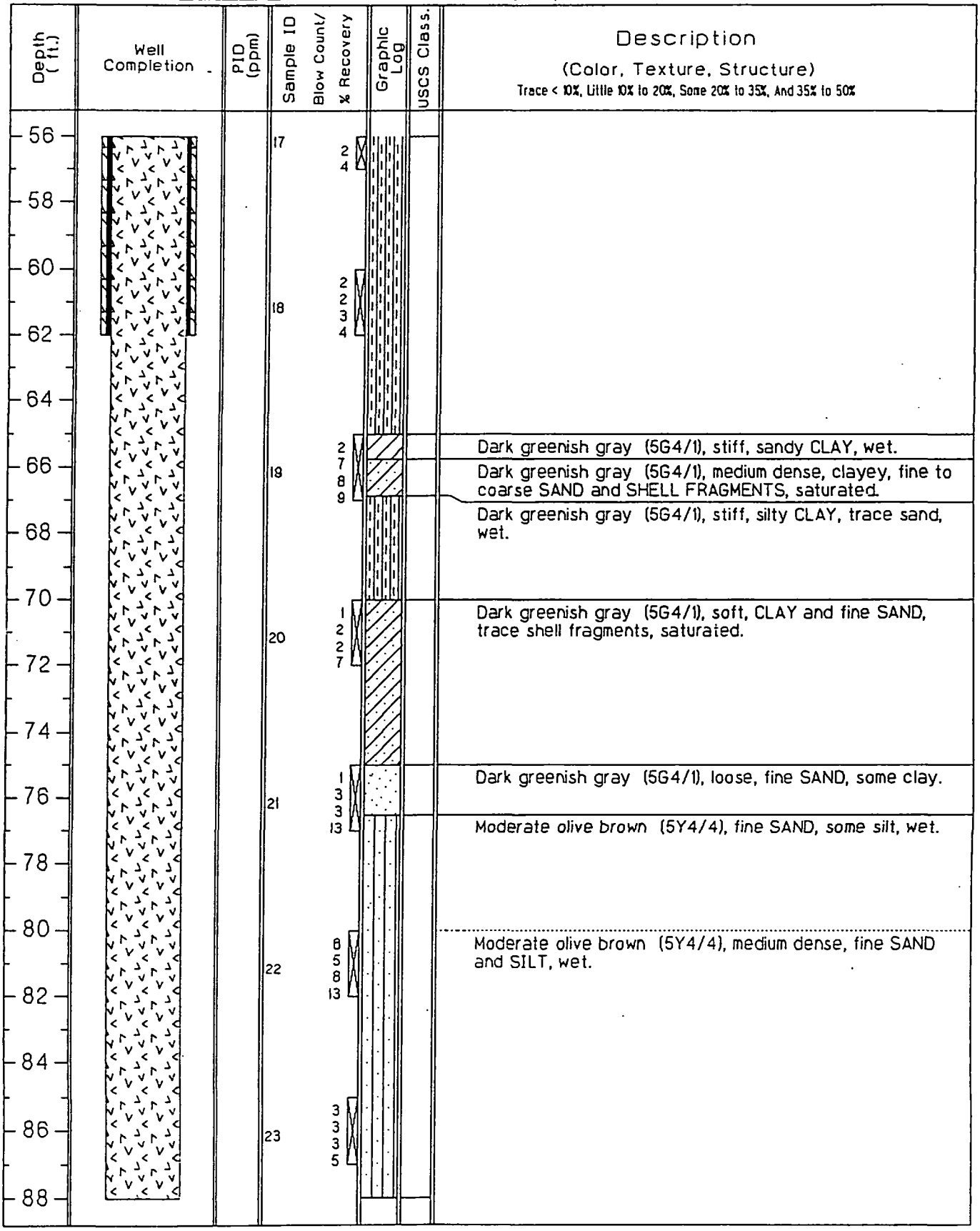
Drilling Log

FLUOR DANIEL GTI

GT-02

Project *Geot Technical Borings* Owner *City of Charleston, South Carolina*

Location *Calhoun Park* Proj. No. *010030790-02*



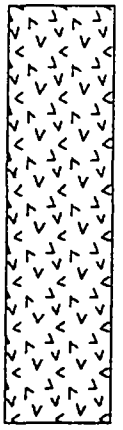
Drilling Log

FLUOR DANIEL GTI

GT-02

Project *Geot Technical Borings* Owner *City of Charleston, South Carolina*

Location *Calhoun Park* Proj. No. *010030790-02*

Depth (ft.)	Well Completion	PID (ppm)	Sample ID	Blow Count / % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
88							Moderate olive brown (5Y4/4), medium dense, fine SAND and SILT, wet.
90			24	2 3 5 8			
92							
94							
96			25	2 2 2 4			
98							Boring terminated at 97 feet.
100							
102							
104							
106							
108							
110							
112							
114							
116							
118							
120							

Drilling Log

FLUOR DANIEL GTI

GT-03

Project *Geotechnical Borings* Owner *City of Charleston, South Carolina*
Location *Calhoun Park* Proj. No. *010030790-02*
Surface Elev. _____ Total Hole Depth *77 ft.* Diameter *12 in. to 4 in.*
Top of Casing _____ Water Level Initial *4 ft.* Static _____
Screen: Dia _____ Length _____ Type/Size _____
Casing: Dia *8 in. and 4 in.* Length *15 ft. and 62 ft.* Type *Schedule 40 PVC*
Fill Material _____ Rig/Core *GP-1000*
Drill Co. *R. Simmons Drilling* Method *Mud Rotary*
Driller *M. Armstrong* Log By *E. Fox* Date *08/20/97* Permit # _____
Checked By *C. Wingerd* License No. _____

See Site Map For Boring Location

COMMENTS:

Depth (ft.)	Well Completion	PID (ppm)	Sample ID	Blow Count / % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
-2 to 24							
0			1	5 7 3 4			Dark yellowish orange to moderate yellowish brown, loose, fine SAND, some medium sand and silt, moist.
2			2	10 13 4			Light gray CONCRETE, severely weathered.
4			3	1 1 1 1/12"			Dark olive gray, very soft, gravelly CLAY, some sand and wood fragments, saturated, sheen, odor.
6			4	1/12" 1/12"			Dark olive gray, very soft, sandy CLAY, some organic plant matter, saturated, sheen, odor.
16			5	WH			Dark greenish gray (5GY4/1), very soft CLAY, trace fine sand, wet, no sheen or odor.
20			6	WH			Dark greenish gray (5GY4/1), very soft, fine SAND and CLAY, wet.

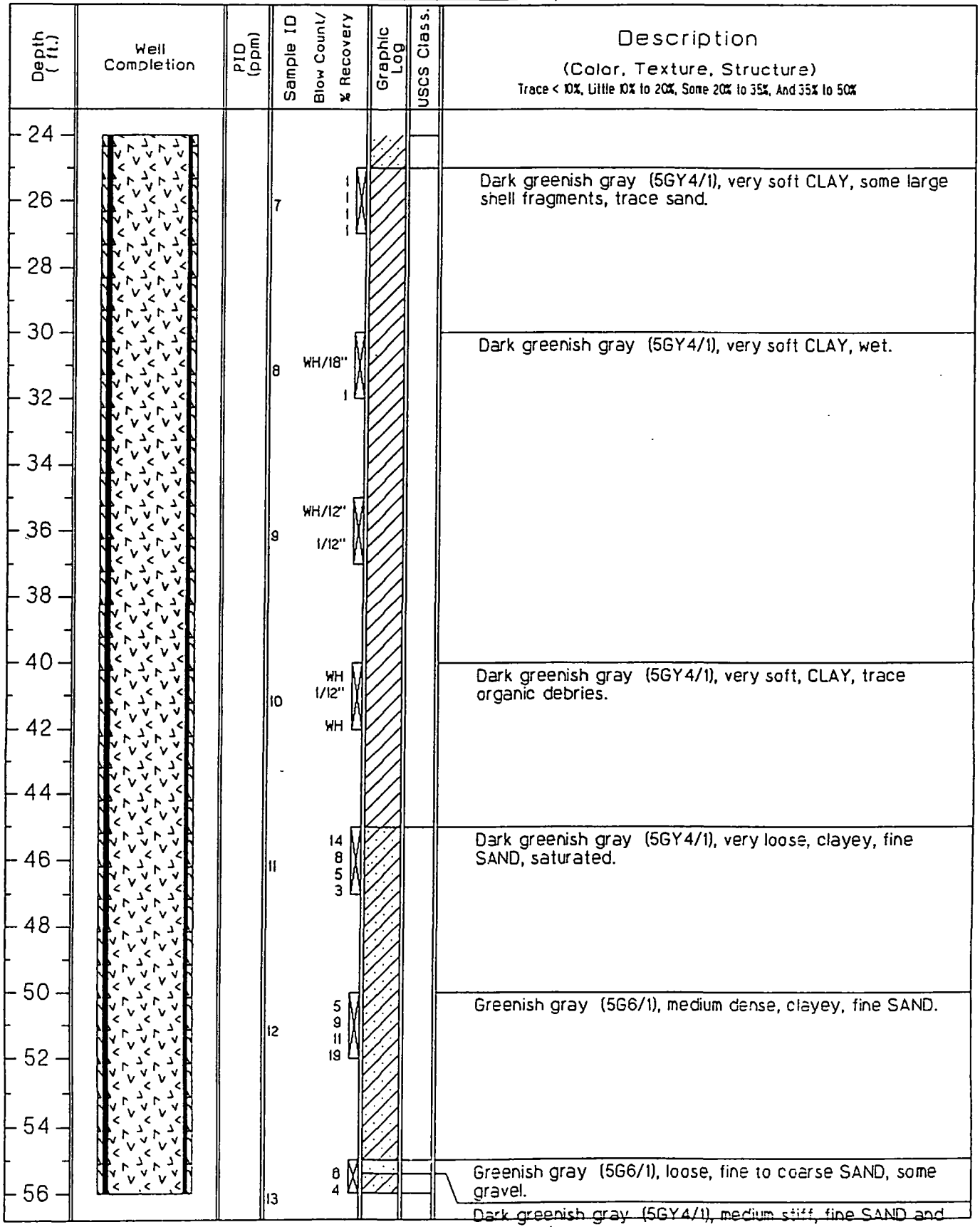
Drilling Log

FLUOR DANIEL GTI

GT-03

Project *Geotechnical Borings* Owner *City of Charleston, South Carolina*

Location *Calhoun Park* Proj. No. *010030790-02*



Drilling Log

FLUOR DANIEL GTI

GT-04

Project *Geotechnical Borings* Owner *City of Charleston, South Carolina*

Location *Calhoun Park* Proj. No. *010030790-02*

Surface Elev. _____ Total Hole Depth *97 ft.* Diameter *12 in. to 4 in.*

Top of Casing _____ Water Level Initial *1.5 ft.* Static _____

Screen: Dia _____ Length _____ Type/Size _____

Casing: Dia *8 in. and 4 in.* Length *15 ft. and 62 ft.* Type *Sched. 40 PVC*

Fill Material _____ Rig/Core *GP-1000*

Drill Co. *R. Simmons Drilling* Method *Mud Rotary*

Driller *M. Armstrong* Log By *E. Fox* Date *08/21/97* Permit # _____

Checked By *C. Wingerd* License No. _____

See Site Map For Boring Location

COMMENTS:

Depth (ft.)	Well Completion	PID (ppm)	Sample ID	Blow Count/ % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
-2 to 24			1	2 3 7 8			Dark yellowish brown, loose, fine SAND and SILT, moist to saturated, sheen, odor.
			2	8 8 4 3 2 1			Dark olive brown, loose, fine to coarse GRAVEL, some coarse sand, tarry, sheen, odor.
			3	1 2 1 7 4			Dark olive brown, loose, fine to coarse GRAVEL, some coarse sand and wood chips, some tar, sheen, odor.
			4	2 1			Olive gray, loose, fine to coarse SAND, some fine to medium gravel, sheen, odor.
			5	WH			Olive gray, medium stiff CLAY, wet, odor.
			6	WH			Grayish olive, very soft CLAY, H2S (rotten egg-like) odor.
			7	WH			Grayish olive, very soft CLAY, some fine sand, odor.

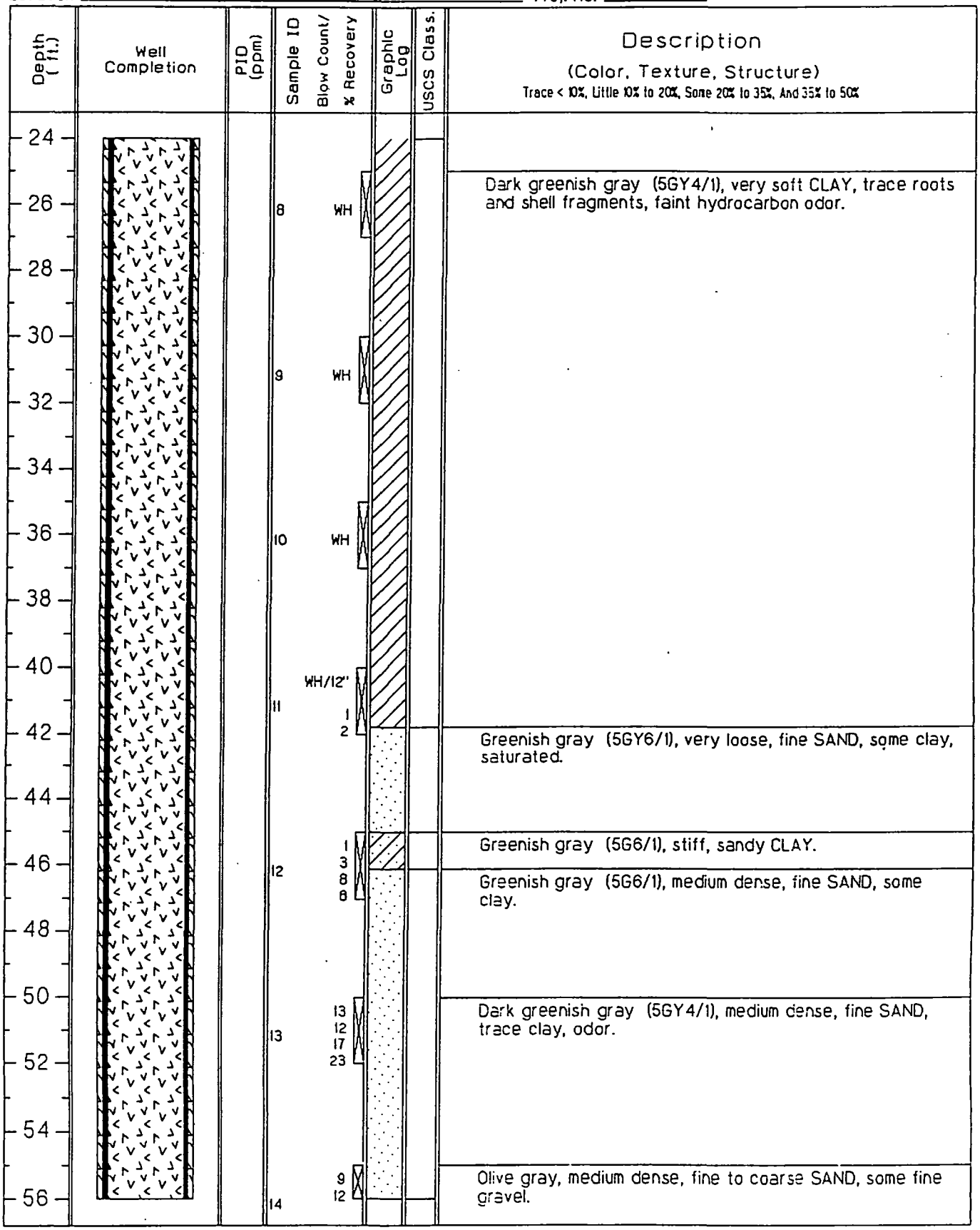
Drilling Log

FLUOR DANIEL GTI

GT-04

Project *Geotechnical Borings* Owner *City of Charleston, South Carolina*

Location *Calhoun Park* Proj. No. *010030790-02*



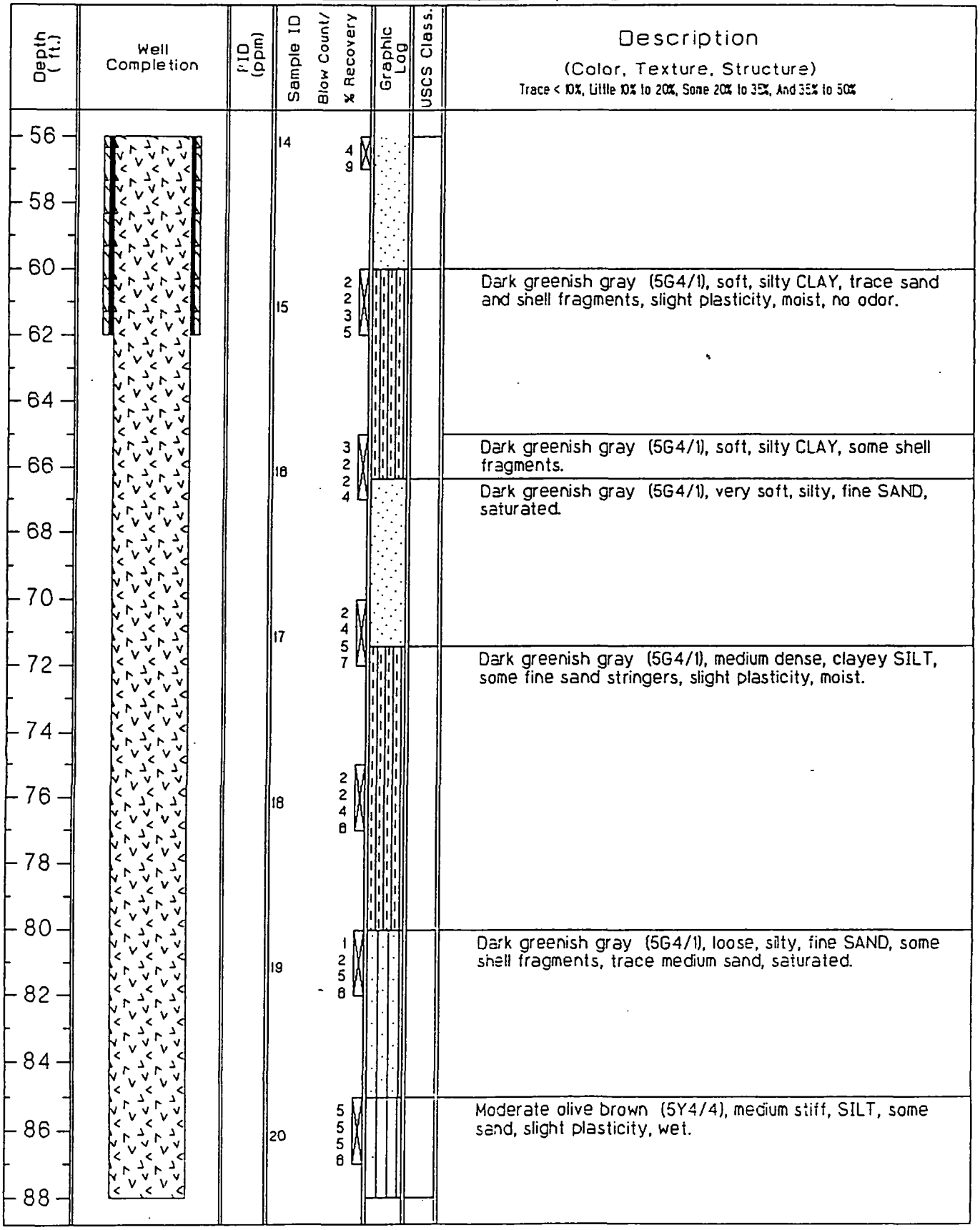
Drilling Log

FLUOR DANIEL GTI

GT-04

Project Geotechnical Borings Owner City of Charleston, South Carolina

Location Calhoun Park Proj. No. 010030790-02



Depth (ft.)	Well Completion	PID (ppm)	Sample ID	Blow Count/ % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
56			14	4 9			
58							
60				2 2 3 5			Dark greenish gray (5G4/1), soft, silty CLAY, trace sand and shell fragments, slight plasticity, moist, no odor.
62			15				
64							
66			16	3 2 2 4			Dark greenish gray (5G4/1), soft, silty CLAY, some shell fragments.
68							Dark greenish gray (5G4/1), very soft, silty, fine SAND, saturated.
70				2 4 5 7			
72			17				Dark greenish gray (5G4/1), medium dense, clayey SILT, some fine sand stringers, slight plasticity, moist.
74							
76			18	2 2 4 6			
78							
80				1 2 5 6			Dark greenish gray (5G4/1), loose, silty, fine SAND, some shell fragments, trace medium sand, saturated.
82			19				
84							
86			20	5 5 5 6			Moderate olive brown (5Y4/4), medium stiff, SILT, some sand, slight plasticity, wet.
88							

Drilling Log

FLUOR DANIEL GTI

GT-04

Project *Geotechnical Borings* Owner *City of Charleston, South Carolina*

Location *Calhoun Park* Proj. No. *010030790-02*

Depth (ft.)	Well Completion	PID (ppm)	Sample ID	Blow Count/ % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
88							Moderate olive brown (5Y4/4), medium stiff, SILT, some sand, slight plasticity, wet.
90							
92			21	18 15 20 21			
94							
96			22	3 4 6 7			
98							Boring terminated at 97 feet.
100							
102							
104							
106							
108							
110							
112							
114							
116							
118							
120							

Drilling Log

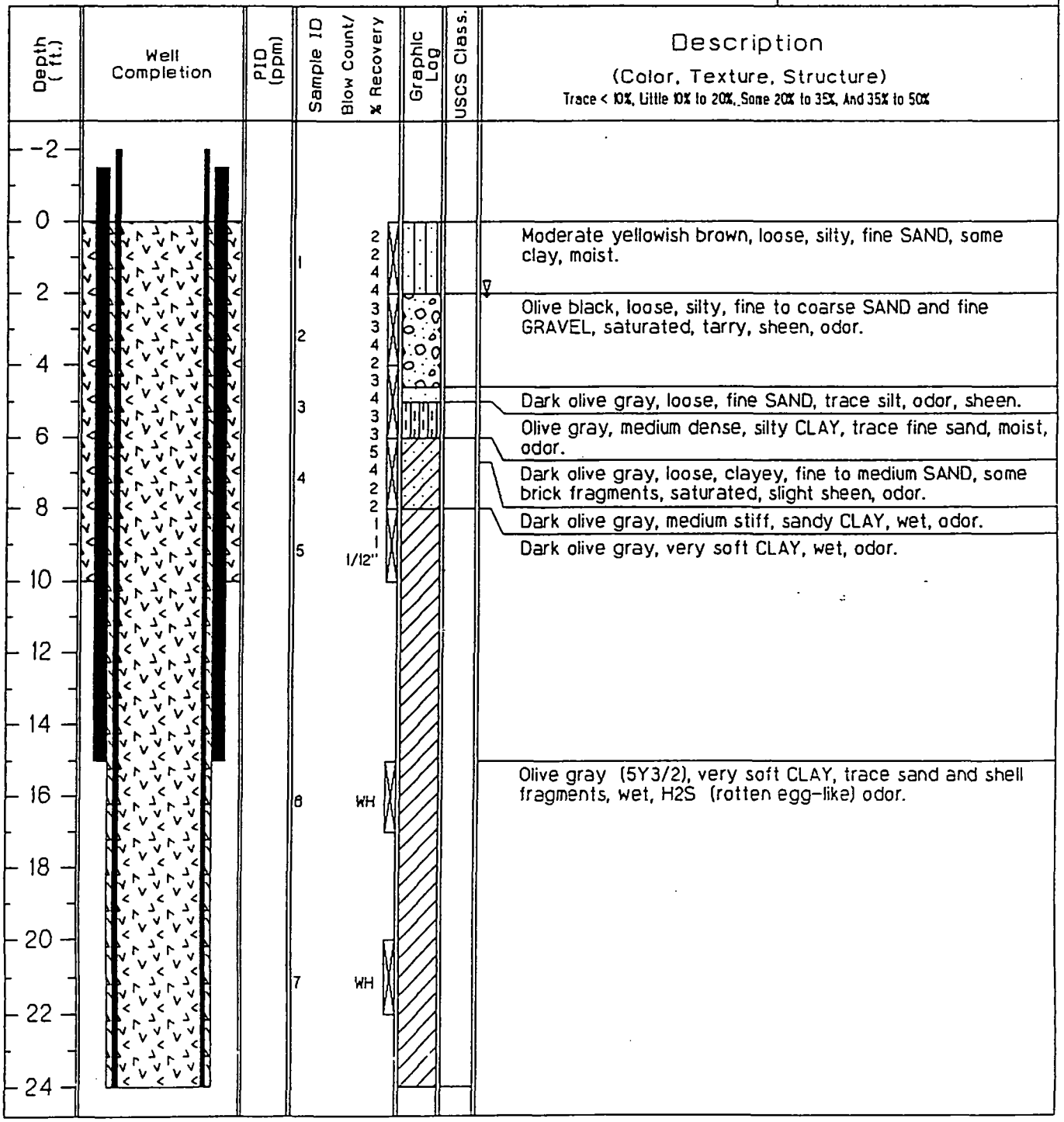
FLUOR DANIEL GTI

GT-05

Project Geotechnical Borings Owner City of Charleston, South Carolina
Location Calhoun Park Proj. No. 010030790-02
Surface Elev. ____ Total Hole Depth 82 ft. Diameter 12 in to 4 in.
Top of Casing ____ Water Level Initial 2 ft. Static ____
Screen: Dia ____ Length ____ Type/Size ____
Casing: Dia 8 in. and 4 in. Length 15 ft. and 63 ft. Type Schedule 40 PVC
Fill Material ____ Rig/Core GP-1000
Drill Co. R. Simmons Drilling Method Mud Rotary
Driller M. Armstrong Log By E. Fox Date 08/21/97 Permit # ____
Checked By C. Wingerd License No. ____

See Site Map For Boring Location

COMMENTS:



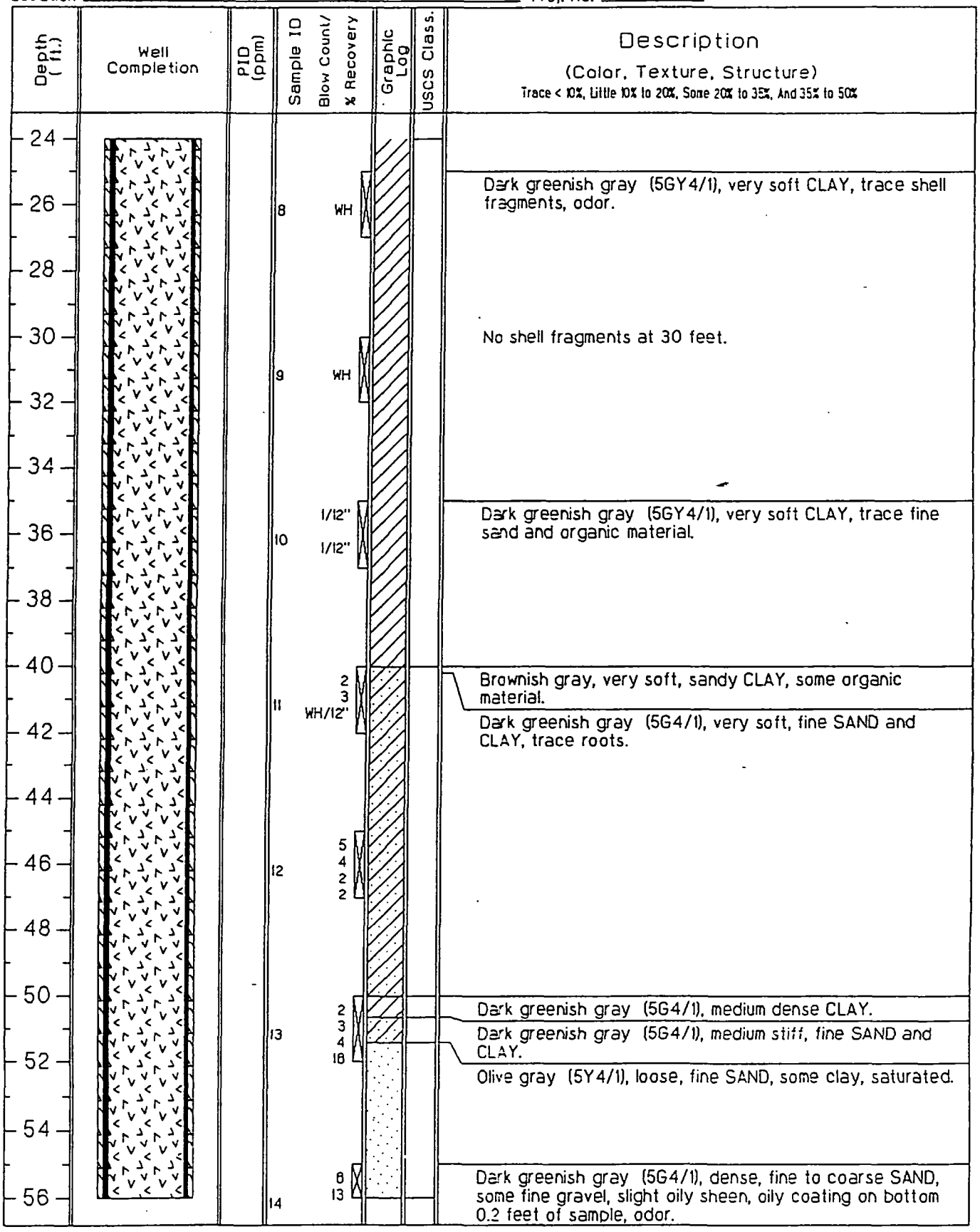
Drilling Log

FLUOR DANIEL GTI

GT-05

Project *Geotechnical Borings* Owner *City of Charleston, South Carolina*

Location *Calhoun Park* Proj. No. *010030790-02*



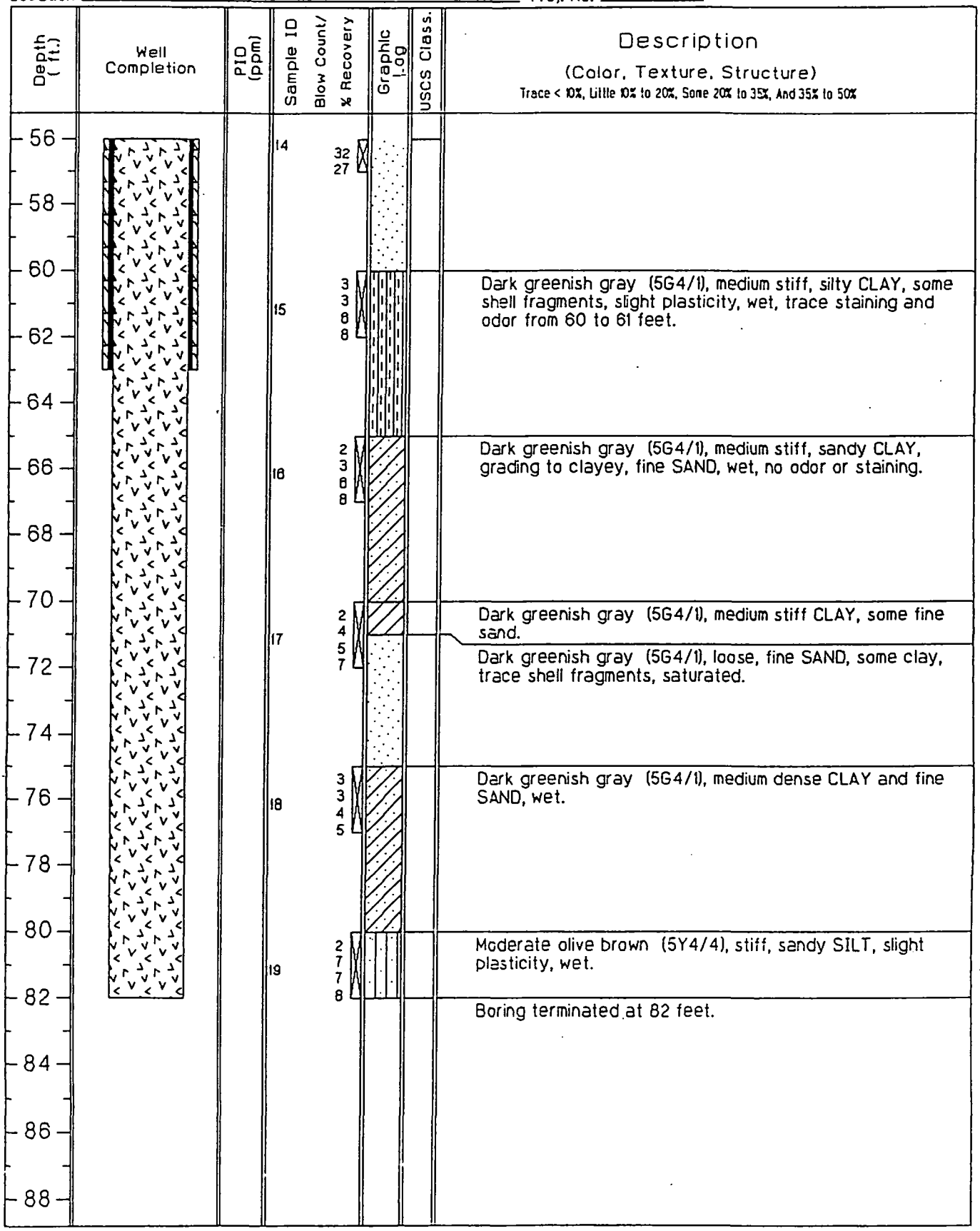
Drilling Log

FLUOR DANIEL GTI

GT-05

Project *Geotechnical Borings* Owner *City of Charleston, South Carolina*

Location *Calhoun Park* Proj. No. *010030790-02*



Drilling Log

FLUOR DANIEL GTI

GT-06

Project *Geotechnical Borings* Owner *City of Charleston, South Carolina*
Location *Calhoun Park* Proj. No. *010030790-02*
Surface Elev. ____ Total Hole Depth *92 ft.* Diameter *12 in. to 4 in.*
Top of Casing ____ Water Level Initial *2 ft.* Static ____
Screen: Dia ____ Length ____ Type/Size ____
Casing: Dia *12 in and 4 in.* Length *15 ft. and 57 ft.* Type *Schedule. 40 PVC*
Fill Material ____ Rig/Core *GP-1000*
Drill Co. *R. Simmons Drilling* Method *Mud Rotary*
Driller *M. Armstrong* Log By *E. Fox* Date *08/20/97* Permit # ____
Checked By *C. Wingerd* License No. ____

See Site Map For Boring Location

COMMENTS:

Depth (ft.)	Well Completion	PID (ppm)	Sample ID	Blow Count/ % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
-2							
0			1	4 3 4			Moderate brown to dark yellowish orange, loose, SAND and SILT, moist.
2			2	3 6 7			Olive black, loose, fine SAND, some silt, moist, coal tar-like odor, oily coating. Saturated.
4			3	8 8 7			Olive gray, medium dense, silty, fine SAND, some brick fragments, odor.
6			4	13 8 8			Olive gray, loose, fine to coarse SAND and GRAVEL, sheen, odor.
8			5	5 3 8			Gray, medium stiff, CLAY, wet.
10			6	4 1/12" 1/12"			No Recovery. Gray, very soft CLAY, wet, no odor.
12				1/12"			
14							
16			7	WH			Olive gray, very soft. CLAY, trace sand and organic material, wet, H2S (rotten egg-like) odor.
18							Shelby tube pushed from 18 to 20 feet.
20			8	WH			
22							
24							

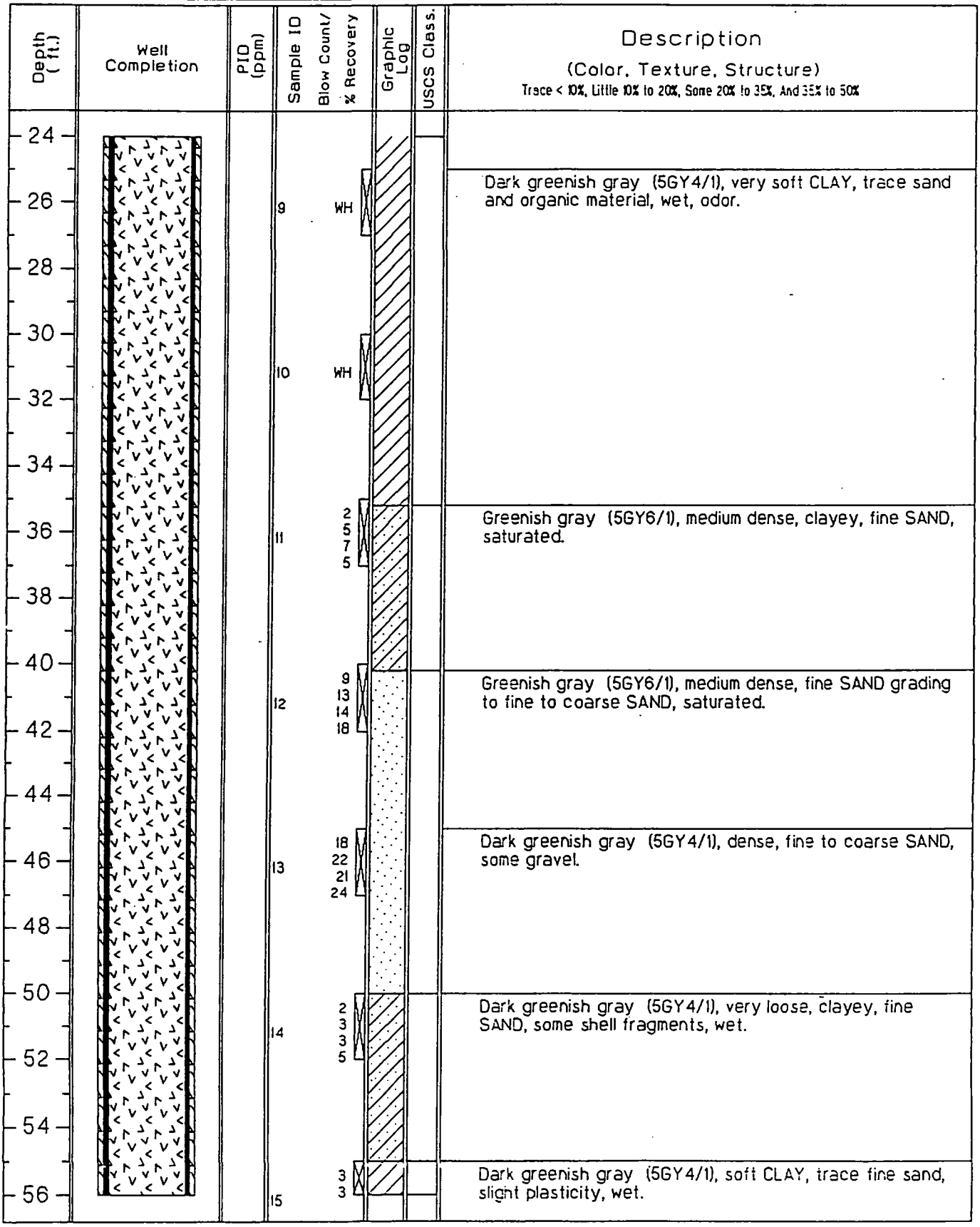
Drilling Log

FLUOR DANIEL GTI

GT--06

Project *Geotechnical Borings* Owner *City of Charleston, South Carolina*

Location *Calhoun Park* Proj. No. *010030790-02*



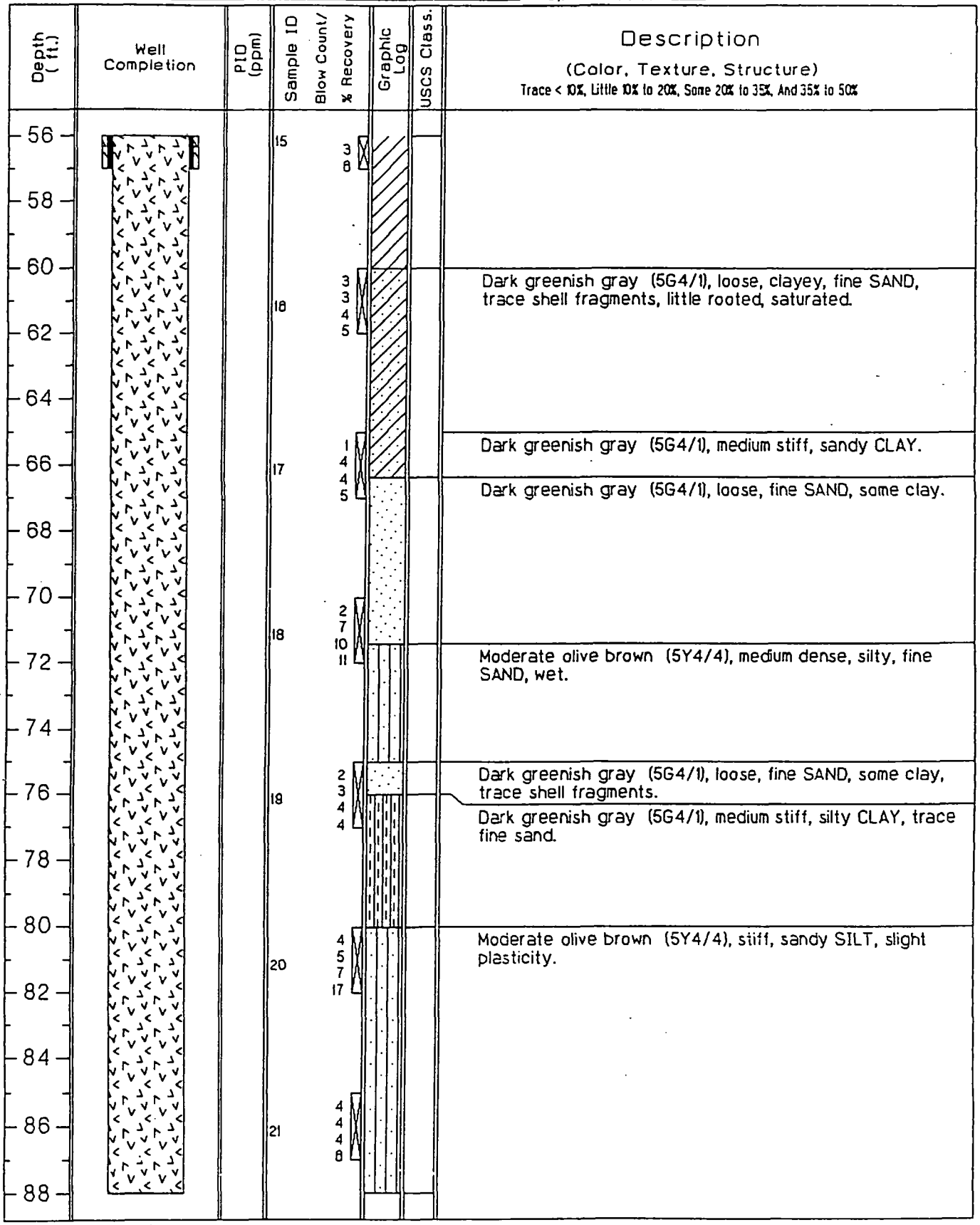
Drilling Log

FLUOR DANIEL GTI

GT-06

Project *Geotechnical Borings* Owner *City of Charleston, South Carolina*

Location *Calhoun Park* Proj. No. *010030790-02*



Drilling Log

FLUOR DANIEL GTI

GT-06

Project *Geotechnical Borings* Owner *City of Charleston, South Carolina*

Location *Calhoun Park* Proj. No. *010030790-02*

Depth (ft.)	Well Completion	PID (ppm)	Sample ID	Blow Count/ % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
88							
90				3			
			22	4			
92				6			
				8			Boring terminated at 92 feet.
94							
96							
98							
100							
102							
104							
106							
108							
110							
112							
114							
116							
118							
120							

APPENDIX C
FIELD NOTES

8/12/97 SUNNY+CLEAR

0702 - PRIOR DANIEL GTI REP EDWIN FOX ON SITE - UNLOCK GATE BUT GET CHASED OFF BY SKEETERS ...

0720 - LEAVE SITE IN SEARCH OF INSECT REPELLANT

0745 - RETURN TO SITE

CHUCK + DOUG FROM STATE BUILD DECON PAD

0810 - CALL FT SLT + W. MURDOCK'S WAS NOT IN, BUT INFORMED THE PERSON WHO ANSWERED THE PHONE WE WILL BEGIN DRILLING ON CALHOUN PARK + WILL BE GOING INTO THE SUBSTATION FOR EQUIPMENT —

0830 - RETURN TO SITE —

CHARLIE TILL (USEPA) ON SITE.

- DRILLERS ARRIVE AS I MEET CHARLIE.

DRILLERS DON'T HAVE ANY 8" CASING SO CALL OFFICE 8" CASING IN SUBSTATION

~~09~~

0920 - 0940 TAILGATE SAFETY MEETING

0945 DRILLERS UNLOAD EQUIP

RUN OVER TO SUBSTATION TO GET 8" CASING

1030 - ATTEMPTS TO TURN ON H2O IN S/E SIDE OF SITE UNSUCCESSFUL

8/12/97

- CALL M. VALARIO - TALK TO MURRY BRENNAN @ FLEE DAY (AQUARIUM)

- CALL WATER DEPT LEAVE MESSAGE W/ RICK BICKERSTAFF ABOUT ACCESS TO HYDRANT

RICK PUT ME IN TOUCH W/ AT

SAID NO HYDRANT METERS AVAILABLE. NEED TO GET A LINE SET UP.

1130 - SEND DRILLERS TO FIRE STATION WHILE FTF GOES TO SCE&G LEADS AVE TO SEE IF SOMEONE THERE CAN HELP LOCATE WATER SOURCE - THEY WERE NO HELP

- W. MURDOCK IS OUT TODAY

12:30 RETURN + DO LUNCH

1330 BEGIN SAMPLING GT-02

DRILL RIG - GUSPECH GP-1000

DRILL BIT = 12" DIAMETER

1550 SET CASING @

8/12/97

GTO 2

0-2	1.6	MOD YEL BRN & DK OL GRY F-M SAND, SOME F GRAVEL & SILT
T-10-12.5		
1336		1.4-1.6 BRICK FRAG. MOIST
2-4		2-2.5 - BROWN BRK TO DK GRY F-M SAND, SOME SILT SATURATED
1338	5-50/6"	
	1.0	2.5-3 WOOD FRAG. FROM A-BEAM OR TIMBER
4-6	2.4-7.9	100 RECOVERY
1402	0.8	STILL GETTING WOOD IN RETURN WATER POSSIBLY A STUMP
6-8	3.2.1.1	6-6.5 DK YEL BRN F SAND, SOME SILT
1433	1.25	6.5-6.6 OL BLACK SANDY PEAT
		6.6-8 DK GRAY VERY SOFT CLAY, SOME SILT
8-10	1/12", 1/12"	SAA
1448	0.3	
10-12	1/12", 1/12"	SAA
1456	0.3	
12-14	1/12", 1.1.1	12-13.5 SAA
1514	2.0	13.5-13.55 SHELL FRAGS
		13.55-14 SA 12-13.5'
14-16	1/12" - 1/12"	SAA
1530	1.8	
17-19	1/24"	SAA
1540		

8/13/[illegible] SUNNY + CLEAR

0700 · [illegible] ARRIVE ON SITE FOR ONSITE

0720 · DRILLERS ONSITE

0730 · GET H2O, TAILGATE SAFETY MEETING

07[illegible] · [illegible]

0800 · BEGIN SAMPLING GT-03

ENCOUNTER WOOD FRAGS @ 2.5'

MOVE HOLE 5' NORTHWEST

~~0830~~ ETF [illegible]

0815 · GREG (SHAW) ONSITE W/ SAMPLES FROM PREVIOUS JOBS OF THE MARL FOR REFERENCE

· NEEDS 15-17' SAMPLE SO CAN'T PUSH CASING PAST 15'

0[illegible] · [illegible] TO SAMPLE GT-01 BECAUSE GT-03 IS CONTAMINATED & WILL HAVE TO DECON TUBS + TOOLS AFTERWORDS!

0910 · BEGIN SAMPLING GT-01

· ENCOUNTER 4' OF WOOD CLOGGING ALL HOSES

· VERY STRANGE ODOR · UNIDENTIFIABLE

11:15 · INFORM MIKE WE WILL TAKE LUNCH + THAT HE SHOULD LOOK INTO THE STATUS OF HIS DRUMS

· MIKE SAID HOLE IS CROOKED BECAUSE OF WOOD

1130 CALL CUNNINGHAM, G. GRANADO (ADGT) INFORM THEM OF THE SITUATION W/ GT-01 + THAT I HAVE DECIDED TO ABANDON THE BORING

· CHAZ THINKS THE ODOR IS FROM THE WOOD PITCH DISTILLERY WHICH WAS HERE

· GREG WILL CALL CLARENCE MATHEWS AROUND 2

1230 - RETURN TO SITE CHECK ETO SEE IF M. SHAKESPEAR IS 10-20

· DST BRINGS DRUMS + DRILL SUPPLIES

12:45 · DRILLERS GO FOR WATER + BEGIN GROUTING

1400 · BEGIN GT-01A SAMPLING

- CLAY @ 7.5'

1430 · DRILL TO 10.0' PREP TO SET CASING

1447 · SET CASING. PUSHED CASING FROM 10-15'

1517 - FINISH GROUTING CASING

CLEANUP SITE

MOBE TO GT-06

GET H_2O

8/13/97

GT-03

0-2	5-7-3-4	DK YEL OR -10 MOD YEL BRN F SAND, SOME M SAND, MOIST
0 1	1.25	
2-4	10-13-4-1	2-2.5 SAA
2	0.7	2.5-2.7 LT GRY WEATHERED CONCRETE MOIST
4-6	1-1/12"	DK OL GRAY GRAVELY CLAY
3	0.25	SOME SAND + WOOD FRAGS. SATURATED, SHEEN, ODOR
6-8	1/2" 1/2"	DK OL GRAY, VERY SOFT SANDY
4	1.3	CLAY, SAT SOME PLANT MATERIAL SAT, SHEEN, ODOR

GT-01

0-2	4-5-8-6	MOD YEL BRN F-M SAND
	1.5	SOME SILT, MOIST
2-4	5-10-7-6	2-2.25 SAA
	1.75	2.25-4 VERY DK GRAY, SILTY, F SAND SOME ORGANIC DEBRIS, MOIST
4-6	8-7-10-15	4-4.75 GRY OL BRN, SILTY F-C SAND, SATURATED
	0.75	4.75-6 BRICK FRAGS + WOOD FRAGS, SAT
6-8	10-12-15-20	6-6.5 WOOD FRAGMENTS
	1.5	6.75-8 WEATHERED BRICK & CONCRETE FRAGS, SAT W/ IDENTIFIABLE ODOR (LIKE DICK'S) W/O SHEEN
8-10	15-7-9-14	WOOD FRAGMENTS
	1.0	
10-12	13-10-12-15	SAA, SOME CLAY
	1.5	

8/13/97 GT-01A

0-2 4.5.6.10
1 1.6 MOD YEL BRN F M SAND
SOME SILTY, TR GRAVEL, SL MOIST

2-4 10.15.? 2-2.8 SAA
2 1.0 2.8-4 BRN BLACK WOOD FRAGS
MOIST

4-6 2.3.4.4 4-4.25 LT DK GRY, F SAND, DAMP
3 1.5 4.25-6 SAA BRN BLACK, SANDY
PEAT, DAMP TO MOIST

6-8 ?.1.1.1 6-6.5 SAA
4 2.0 6.5-7.5 GRAY, CLAYEY, F-C SAND + GRAVEL, SAT, SLIGHT PINESOL ODOR
7.5-8 GRAY CLAY, SAT

8-10 WH
5 0.5

GT-06

0-2 4.3.4.3 0-0.75 MOD BRN TO DK YEL OR
1 1.75 SAND + SILT, MOIST
0.75- OL BLACK F SAND, SOME
SILT, COAL TAR LK ODOR
OILY LK COATING

2-4 6.7.6.6 SAA, SATURATED
2 2.0

4-6 7.13.8.6 OL GRAY, SILTY, F SAND, BRICK
3 1.5 FRAGMENTS SAT, ODOR

6-8 5.3.6.4 6-7.25 SAA, F-C SAND & GRAVEL SHEEN
4 2.0 7.25 GRAY CLAY SOME WHITE
SILTY NODULES, WET,

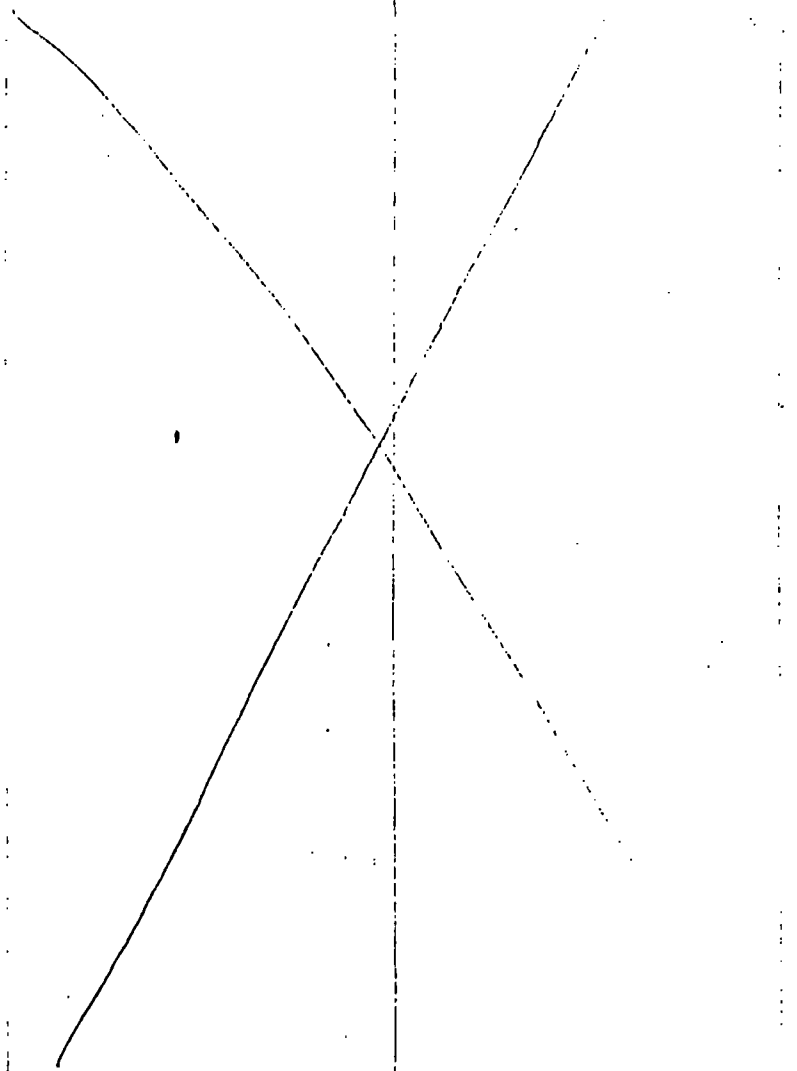
8-10 1.1.1 ~~SAA~~ NO RECOVERY ETF 8/13/97
5 0.0

10-12 1.1 GRAY CLAY, WET, NO ODOR
6 2.0

8/13/77

1840 - FINISH DRILLING TO 10' @ GT-06

1730 - FINISH CREDITING 12" CASING
- 12" BORING TO 10'
- PUSHED 8" CASING FROM 10' TO 85'
- GROUT (TREMMIED FROM 10' TO 0'



8/14/97 MOSTLY SUNNY

0700 · [illegible] ETF KEP E. FOX ONSITE

0713 · DRILLERS ONSITE

0715-0720 · [illegible] SAFETY MEETING

0725 · RUN FOR H_2O

0730 · SET UP TO DRILL OUT GT-03

CALIBRATE HNU

	PPM	SPAN	PASS
INITIAL PPM	98	0.80	Y
FINAL	100	7.50	N

CALIBRATION GAS: 100PPM ISOBUTYLENE LOT 71 : 3-138

0758 · BACKGROUND ORGANIC VAPOR CONCENTRATION 0.0 PPM

0800 · BEGIN DRILLING TO 10' TO SET CASING

0805 · 0.0 PPM

0815 · PREP TO [illegible] GROUT

0818-0830 · ETF [illegible] TO GET [illegible]

0845 · FINISH GROUTING - USE 2 BATCHES OF GROUT - CASING TO 15' GROUT [illegible]

0900 · FINISH CLEAN UP

0930 · SETUP ON GT-05

0935 · BEGIN SAMPLING GT-05

1000 · FINISH SAMPLING, REAM OUT HOLE

1030 · FINISH DRILLING TO 11' & SETTING CASING @ 15', PREP TO GROUT

8/14/97

1040 CLEANUP SITE, ETF CALLS ABOUT WATER

1110-1130 SAMPLE GT-04

· SET UP TO DRILL

· DRILLERS RUN FOR H_2O

1130 LUNCH ETF GOES TO GET [illegible]

1240 - ETF RETURNS

· JERRY EBELING W/ CPW ON SITE TO FIGURE OUT WHERE WE CAN GET H_2O

· THE LINE SUPPLYING THE RHODES [illegible] WAS DISCONTINUED BECAUSE OF A WATER LINE BREAK

· JERRY SAID HE WILL HAVE A BACKFLOW PREVENTOR MADE UP SO WE CAN GET H_2O FROM A HYDRANT

1310-1325 DRILL GT-04 TO 11' DRILL W/ MUD FROM 8' TO 11' TO PREVENT ANY CAVE IN - PUSH CASING TO 15'

1409 - FINISH GROUTING IN CASING

1445 · SETUP @ DECON

1500-1510 DECON - CITAL RECOMENDS USING SOAP W/ STEAM

1510 - DRILLERS RUN TO GET FITTINGS

HNU	
1305	0.0
1310	1.5
1330	0.8

8/14/77 GT-04

0-2	2·3·7·6		DK YEL BRN, F SAND + SILT
	1.7		MOIST TO SAT W/ ORG + SHELL
2-4	6·4·3·2		DK GY BRN F-C GRAVEL, SOME
	0.7		COARSE SAND, SAT, TARRY,
			ODOR, SHELL
4-6	1·1·2·1	4-4.75	SAA
	1.25	4.75-6	SAA WOOD CHIPS, ODOR,
			SAT, SOME TAR + SHELL
6-8	4·7·2·1	6-7.1	SAA
	1.9	7.1-7.75	DK GRAY F-C SAND + ~~GRAVEL~~ GTT
			SOME F-M GRAVEL, SAT, SHELL, ODR
		7.75-8	DK GRAY CLAY, SAT, ODR
8-10	WH		SAA
	0.75		

8/14/77 GT-05

0-2	2·4·4·1		MOD WEL ISRD SILTY F
	1.15		SAND, SOME CLAY, ROOTS
2-4	3·5·4·2		DK BRN, SILTY F-C SAND
	0.75		+ F-M GRAVEL, SAT, TARRY
			ODOR, SHELL
4-6	3·4·3·3	4-4.6	SAA
	1.25	4.6-5	DK GY GRAY, FINE SAND,
			TRACE SILT, SAT, ODR
		5-6	DK GRAY, SILTY CLAY,
			TRACE F SAND, MOIST, ODOR
6-8	5·4·2·2	6-6.1	SAA, CLAYEY, F-M SAND,
	1.1		BRICK FRAGMENTS, SAT, SLIGHT
			ODOR
		6.1-8	SAA, SANDY CLAY, SAT,
			ODOR
8-10	1·1·1		DK GY GRAY CLAY, SAT, ODOR
	0.3		

8/14/77

1540 - CONTINUE DECON

1605 - FINISH DECON SET UP FOR HUD

[illegible] / [illegible] GET O2

1645 FINISH SET UP - [illegible] FOR HUD

1705 ALL [illegible] DOWN!

9/…/…   SUNNY, HAZY, HOT

0700   ARRIVE [illegible] ON SITE
0715   HEALTH + SAFETY MEETING
0720   [illegible] CALIBRATION

	PPM	SPAN	O ADJ
INITIAL	88	750	Y
FINAL	100	132	NO

0730 - BEGIN SAMPLING BORING GT-02[illegible]

TIME	PID
0730	0.0
0800	0.6
0830	0.0
0900	0.4
0930	0.2
1000	0.2

0940 · FINISH SAMPLING TO 62' W/ "[illegible]
0945 · BEGIN REAMING BORING TO 62' W/ 8" BIT
· GET H2O
1035   FINISH GETTING WATER
1100 · FINISH REAMING BORING TO 62'
- PULL TOOLS
- PLACE 4" CASING TO 62'
- PREP TO GROUT
1150 - [illegible] TO GET DRUMS + [illegible]

· MIKE + [illegible] GET WATER + TAKE [illegible]
1330   BEGIN MIXING GROUT - MAKE A 7 BAG BATCH OF GROUT
1400 · FINISH GROUTING + CLEANING OUT BORING
- USED A TOTAL OF 7 DRUMS TO CONTAIN WASTE GENERATED FROM 2ND CASING INSTALLATION
1412 - BREAK DOWN RIG + MOBE TO GT-01
1435 - BEGIN SAMPLING GT-01

1640 - FINISH SAMPLING GT-01A TO 57'
PREPARE TO REAM
1720 - FINISH REAMING TO 58' PULL TOOLS
1734 - FINISH PLACING CASING (4") TO 58'
CLEANOUT MUD TUB + PREP TO GROUT
1810 - FINISH PLACING GROUT
BEGIN CLEAN UP
1820 - DEPART

8/15/?? GT 02

20-22 WH 2.0 — 5G? 4/1 DARK GRN GRY, VERY SOFT, F SAND + CLAY, SOME WHITE SHELL FRAGS, SAT. ROTTEN EGG ODOR

25-27 WH/12" 2-1 1.9 — SAA, VERY SOFT CLAY, SOME LARGE (DIA OF SPOON) WHITE SHELL FRAGS, WET FR SAT, ODOR

30-32 1-1 2.0 — SAA, V. SOFT CLAY, TRACE WHITE SHELL FRAGS, WET, ODOR

35-37 WH/6" 1-1 2.0 — SAA, TRACE DK YEL OR SHELL FRAGS, WET, ODOR

40-42 1-3-3-? 1.5 — 40-40.3 SAA, SOME F SAND TRACE SHELLS; 40.5-42 DK 5G 4/1 GRN GRY, F SAND + CLAY SAT

45-47 1-1-2-? 2.0 — SAA CLAYEY, F SAND

50-52 5-6-6-? 0.75 — DK GRN GRY 5G 4/1 TO DK GRN GRY 5G 4/1 FINE SAND, LITTLE CLAY, SAT.

55-57 ?-2-2-4 2.0 — 55-55.5 DK GRN 5G 4/1, F SAND + CLAY; 55.5-57 SAA, SILTY CLAY-TR F SAND, SLIGHTLY PLASTIC, NO ODOR

GT 02 8/15/??

60-62 2-2-3-4 2.0 — SAA

8/15/97 GT-01A

15-17 WH DK GRN GRY 5GY 4/1 VERY SOFT
6 2.0 CLAY, WET, SHELL FRAGS
ROTTEN EGG ODOR

20-22 1.1 SAA
1 2.0

25-27 WR SAA NO SHELL FRAGS, SOME ORGANIC
8 2.0 FIBERS

30-32 WR SAA
9 2.0

35-37 WR SAA
10 2.0

40-42 2.5 2.4 DK GRN GRY (5G 4/1) FINE SAND
11 1.4 , SOME CLAY,

45-47 7.10.14 17 MED GRY F-M SAND, SOME
12 0.75 F-FINE GRAVEL TR C SAND

50-52 3.4.6.7 50-50.25 DK GRN GRY 5GY 4/1
13 1.5 F SAND + CLAY
50.25-51.3 SAA CLAYEY, F SAND
51.3-52 SAA, CLAY + F SAND, SHELL
FRAGS

GT-01A
55-57 2.2.3.5 SAA, SILTY CLAY, SLIGHTLY PLASTIC
14 2.0 SOME SAND (SHELL FRAGMENTS)
WET

8/16/97 SUNNY

0700 - ERFX ONSITE
0710 - DRILLERS ONSITE
· TAILGATE SAFETY MEETING
· REVIEW HEALTH SAFETY PLAN W/

· DISCUSS HOW WE WILL ADVANCE BORING W/O USING CORE BARRELS
· DRILLERS DO NOT HAVE ANY OTHER BITS + THE 8" FISHTAIL BIT BORES OUT THE BOTTOM THE SAME AS OURS

· MOBE TO GT-03
· CALIBRATE HNU

	PPM	SPAN	CAL
	100	7.35	Y

+ [illegible]

0800 BEGIN SAMPLING GT-03

TIME	PPM
0800	0.0
0830	0.0
0900	0.0
0930	0.0
1000	0.0

8/16/97

1000 FINISH SAMPLING TO 62' SET UP TO REAM THE BORING
- GET H2O + TAKE BREAK
1017 - BEGIN REAMING BORING
· BEGIN LOOSING RETURN @ ABOUT 35 FT
· PLACE 3.3 GAL BATCHES OF THICK MUD INTO BORING BEFORE GETTING RETURN

1130 - FINISH REAMING BORING, CLEAN OUT MUD TUB, PREP TO GROUT
1311 - FINISH GROUTING + CLEANING OUT MUD TAB USED 8 1/2 DRUMS TO CONTAIN DRILL WASTE
1315-1415 LUNCH
· SET UP ON GT-06
1500 - BEGIN SAMPLING OF GT-06
1507 - PUSH SHELBY TUBE FROM 18'-20'
LET SHELBY SET FOR 10 MIN BEFORE PULLING

TIME	PID	TIME	PID
1515	0.0	1645	0.0
1545	0.0		
1615	0.0		

1705 - FINISH SAMPLING TO 57'

8/16/?? GT-03

15-17 5	WOH 2.0	DK GRN GRY (5 GY 4/1) VERY SOFT CLAY, TRACE F SAND WET
20-22 6	WOH 2.0	SAA, SANDY CLAY, WET
25-27 7	1.1.1.1 0.75	DK GRN GRY (5 G 4/1) VERY SOFT CLAY, SOME GRAVEL SIZED SHELL FRAGS, TRACE SAND
30-32 8	WH/18".1 2.0	SAA, VERY SOFT CLAY, WET
35-37 9	WH/12".. 2.0	SAA, WOOD FROM 36 TO 36.5' ONLY [illegible] OF SPOON FULL FROM 36-36.5,
40-42 10	WH 1/12" WH 2.0	SAA, TRACE ORGANIC DEBRIES
45-47 11	14 8.5.3 1.3	GRN GRY (5GY 4/1) F SAND, SOME CLAY TO CLAYEY F SAND, SAT FAINT ODOR
50-52 12	5.9.11.19 1.9	50-51 GRN GRY (5G 6/1) CLAYEY FINE SAND, SAT. 51-52 LT GRY F-M SAND SOME CLAY, SAT.
55-57 13	6.4.4.4 1.25	55-55.4 SAA F-C SAND SOME F GRAVEL SAT. 55.4-57 DK GRN GRY (5GY 4/1) F SAND + CLAY, WET
60-62 14	3.3.6.7 2.0	SAA, SILTY CLAY SLIGHTLY MOIST, TRACE SAND + SHELL FRAGS

8/16/17 SGT-06

15.4-17.5 NH OLIVE (5Y 3/2) CLAY, TR SAND
7 2.0 TRACE ORGANIC ROOT MATERIAL
SAT, PETROLEUM ODOR

18-20 SHELBY TUBE
8 2.0' REC.

20-22 WOH SAA
8 2.0'

25-27 WOH DK GRN GRY (5GY 4/1), SAA
9 2.0

30-32 WOH SAA
10 2.0

35-37 2.5 7.5 35.35.2 SAA
11 1.7 35.2-37 GRN GRY (5G 6/1) CLAYEY
F SAND, SAT

40-42 9.13.14.18 40-40.2 SAA
17 1.3 40.2-41 SAA, F SAND GRADING TO
A FINE TO COARSE SAND, SAT

45-47 18.22.21.11 DK GRN GRY (5GY 4/1) F-C SAND
13 1.6 SOME F GRAVEL

8/16/17

50-52 3.2.3.5 SAA, CLAYEY F SAND, FAT=FR SOME
14 1.5 SHELL FRAGS. WET

53-57 3.3.3.6 SAA, SLIGHTLY PLASTIC, SILTY
15 2.0 CLAY, TR F SAND

8/17/97 SUNNY + HOT

0700 - [illegible] E [illegible] (AM) ONSITE
0715 - DRILLERS ONSITE
- [illegible] SAFETY MEETING
- [illegible] TO REAM GT-06 TO 57'
[illegible], SETUP FOR 8"
- CALIBRATE [illegible]

	PPM	SPAN	ADJ.
[illegible]	100	732	Y

0800 - BEGIN REAMING GT-06 W/ 8" BIT

TIME	PID	TIME	PID
0800	0.0	0930	0.0
0830	0.0		
0900	0.0		

0850 - FINISH DRILLING TO 57' PLACE 4" CASING TO 57' + PREP TO GROUT
0930 - FINISH GROUTING IN 4" CASING TO SURFACE
1000 - FINISH CLEANING UP GT-06 SITE
- 4" CASING STILL WANTS TO FLOAT TO MUST KEEP MAST HEAD ON CASING
- GET DRUMS FROM SUBSTATION
- [illegible] OF H2O
1050 SET UP ON GT-05
1115 BEGIN SAMPLING

8/17/97

TIME	PID	TIME	PID
1105	0.0	1430	0.2
1145	0.0	1500	0.0
1300	0.0	1530	0.2
1330	0.0	1600	0.2
1400	0.4		

1200 LUNCH
1305 CONTINUE
1350 - RETRIEVE 55-57' SAMPLE SOIL @ BOTTOM OF SHOE ~~CONTAINED~~ ~~STAINED~~ WAS CONTINUOUSLY [illegible] W/ STRONG NAPHTHALENE [illegible] ODOR.
1400 - FINISH SAMPLING TO 62' FT, PREP TO REAM BOREHOLE W/ 8" BIT
1600 - FINISH INSTALLATION OF 4" CASING TO 63'
1630 - DEPART SITE

8/1/97 GP-05

13-17 WH DK GRY (5Y 3/2) VERY SOFT
6 2.0 CLAY, TRACE SAND & SHELL FRAG
ROTTON EGG ODOR

20-22 WH SAA, LITTLE SAND
7 2.0

25-27 WH DK GRN GRY (5G 4/1) VERY SOFT
8 0.65 CLAY, TR SHELL FRAGS, WET, ROTTON EGG ODOR

30-32 WH SAA, NO SHELLS
9 2.0

35-37 1.1 SAA, TR F SAND & ORGANIC MATERIAL
10

40-42 2.3 WH 40-40.2 BRN GRY, SANDY CLAY,
11 2.0 SOME ORG. DEBRIES
40.2-42 DK GRN GRY (5G 4/1) F SAND
& CLAY, TR ROOTS, WET ODOR.

45-47 5.4.2.4 SAA
12 1.5

8/7/97

50-52 2.3.4.16 50-50.5 SAA, CLAY
2.0 50.5-51.4 SAA, F SANDY CLAY
51.4-52 DK GRY (5Y 4/1) F-M SAND
SOME CLAY

55-57 6.13.32.27 DK GRN GRY (5G 4/1)
1.0 SAA, F-C SAND SOME F
GRAVEL, SLIGHT OILY SHEEN
BOTTOM 0.2' OF SAMPLE OILY
COATING W/ NAPHTHALENE LIKE
ODOR

60-62 3.3.6.8 SAA, SILTY CLAY, SOME
2.0 SHELL FRAGS, SLIGHTY PURPLE
TRACE STAINING & ODOR FROM 60-61

8/18/?? SUNNY-WET

0715 - POSITIVE E. FOX ONSITE
PREP FOR DAY

0730 - CALL MOORE DRUMS TO FIND OUT
AVAILABILITY OF DRUMS
THEY AVAILABLE UNTIL 1100
- CALL G. CROMWELL FOR SCHEDULE
- FINISH GEOTECH THICKS, INSTALL
WELLS FRIDAY

0745 - DRILLERS ON SITE
- TAILGATE SAFETY MEETING
- WILL SAMPLE GT-04 IF ENCOUNTER
DNAPL WILL STOP UNTIL GET
DRUMS

0850 - BEGIN SAMPLING GT-04
HNU CALIBRATION

	PPM	SPAN	ADJ
INITIAL	99	7.32	N
FINAL	100	7.24	N

	TIME	PPM	TIME	PPM
0846	0900	0.0	1130	0.2
	0930	0.2	1200	0.2
	0950	0.0		
	1000	0.0		

- SOME EMULSIFIED DNAPL ON RETURN WATER AFTER
DRILLING THROUGH 25-27' INTERVAL

1020 - FINISH SAMPLING TO 62'
1027 - MIKE & CHRIS LEAVE TO CONTACT DENNIS [illegible]
ABOUT STATUS OF THE 4" ROTARY RIG
ETF CALLS ABOUT STATUS OF DRUMS
10-15 DRUMS AVAILABLE & MORE
DRUMS
1055 - GALE LEAVES TO GET DRUMS
1115 - PREP TO REAM OUT GT-04 TO 62'
1125 - REAM
1150 - FINISH REAMING CASING TO 62'
1205 - GALE RETURNS W/ MORE DRUMS 10
- PREP TO GROUT
1245 - FINISH GROUTING IN CASING
1235-1405 LUNCH
CONTINUE CLEANING AT SITE
1430 - FINISH DRUM MIXING CUTTINGS
1436 - GALE RETURNS W/ 14 MORE DRUMS
1440 - ETF CALLS S+ME TO GET THE COMPANY NAME AND
PHONE # OF FRANK EATON TO SEE IF HE
WOULD HAVE A SIDE DISCHARGE BIT WE COULD
BORROW
1500 - DRILLERS BEGIN DECON OF TOOLS & RIG
1510 - FRANK EATON & BRIAN JOHNSON (SOIL CONSULTANT)
ON SITE TO SEE IF THEY HAVE ANYTHING
WHICH WILL WORK W/ NX PIPE, - NO

8/18/9?   GT-04

15-17 6	WH 1.0	GRY OL (10Y 4/2) VERY SOFT CLAY, ROTTEN EGG ODOR.
20-22 [illegible]	WH 2.0	SAA, SOME F SAND
25-27 8	WH 2.0	DK GRY GRN (5GY 4/1) VERY SOFT CLAY TRACE ROOTS ORGANICS + SHELL FRAGS, FAINT HYDROCARBON ODOR
30-32 9	WH 2.0	SAA
35-37 10	WH 2.0	SAA
40-42 11	WH/12" 1.2 2.0	40-41.8 SAA 41.8-42 SM, F SAND, SOME CLAY SAT, FAINT HYDROCARBON ODOR
45-47 12	1-3-8-10 1.65	45-46.1 GRN GRY (5G 5/1) SANDY CLAY, ODOR 46.1-47 SM, FINE SAND, SOME CLAY SAT, ODOR,
50-52 13	18-17-17-23 1.2	DK GRN GRY (5GY 4/1) F SAND, TR CLAY, ODOR
55-57 14	9-12-14-9 1.0	OL GRY (5Y 4/1) F-C SAND, SOME F GRAVEL, SAT, ODOR
60-62 15	2-2-3-5 2.0	DK GRN GRY (5GY 4/1) SILTY CLAY, TRACE SAND + SHELL FRAGS, SOFT, MOIST, NO ODOR

8/18/?

1525-1535 BREAK

1500 - [illegible] REMOVING OF DRUMS

1600 [illegible] DECON

1600 - [illegible] BREAK

1615 [illegible] TO CONTINUE SAMPLING GT-0[illegible]

17[illegible] [illegible]

17[illegible] [illegible]

- GT CADIUAN (S[illegible]) WAS ON SITE TO PICKUP SHELBY TUBE + CHECK OUT THE STATUS OF THE PROJECT.
  - DISCUSSED THE DESIRED FINAL DEPTH OF THE BORINGS
    - GT 01A - IDENTIFY + SAMPLE TOP OF MARL
    - GT 02 - SAMPLE 20' INTO MARL
    - GT 03 - TOP OF MARL
    - GT 04 - 15' INTO MARL
    - GT 05 - TOP OF MARL
    - GT 06 - 18' INTO MARL

[illegible] SUNNY + HOT

[illegible] - [illegible] ON SITE

07[illegible] - [illegible] ARRIVE ONSITE

[illegible]

[illegible]

[illegible] BELOW GROUND

[illegible] BY THE PROTECTIVE

[illegible] + 9' OF [illegible]

ON THE GROUND

0730 - [illegible]

[illegible] YET CAN'T INSTALL [illegible]

[illegible] UNDER DRUM REMOVAL

[illegible]

[illegible] TO CONTACT [illegible]

08[illegible] [illegible] GO TO LOCATE BITS WHICH

HAVE [illegible] YET + GET OXYGEN

0844 - [illegible] ONSITE TO EVALUATE DRUM [illegible]

0915 - DRILLERS RETURN W/ ~~TOOLS~~ EIF BITS

THAT HAD BEEN DELIVERED TO THEIR ~~[illegible]~~ EIF HOTEL

0930 - BEGIN REAMING HOLE.

- MIX MUD

[illegible] - BEGIN SAMPLING 65-67'

11:56 - RECOVER 80-82' SAMPLE FROM GROUND

12:00 LUNCH

1310 - CONTINUE DRILLING

1320 - [illegible] ONSITE TO [illegible]

[illegible]

1400 - FOREST + [illegible] (CAWN) ONSITE CONFIRM

THAT WE ARE IN THE MARL

+ GOT INTO IT @ 76.5' NO STOP

1440 - FINISH COLLECTING 95-97 SAMPLE

BREAK DOWN RODS + PREP TO GROUT

15:30 - FINISH GROUTING, BEGIN CLEAN UP

1600 - SETUP ON GT-01A

1800 - FINISH SAMPLING TO 77'

1810 - DEPART SITE

6/19/97 GT-02

65-67 2.2.5.7 65-65.75 DK GRN GRY (5G4/1) SANDY CLAY, WET
19 2.0 65.75-66.85 SM CLAYEY, F-C SAND + SHELL FRAGS SAT
66.85-67 SAA SILTY CLAY, TR SAND

70-72 1.2.2.6 SAA, CLAY + F. SAND, VR. SHELL
20 2.0 FRAGS, SAT

75-77 1.3.5.13 75-76.5 SAA, F. SAND, SOME CLAY
21 2.0 76.5-77 MOD. OL BRN. (5Y4/4)
F. SAND SOME ~~CLAY~~ SILT (MARL)

80-82 6.5.8.13 SAA, F. SAND + ~~CLAY~~ SILT
22 2.0

85-87 3.3.3.5 SAA, SILTY ~~CLAYEY~~ F. SAND,
23 2.0

90-92 2.3.5.6 SAA, F. SAND + SILT
24 2.0

95-97 2.2.2.4 SAA
25 2.0

GT-01A

60-62 2.1.2.3 DK GRNGRY 5G4/1, SILTY CLAY
15 2.0 TRACE PLANT MATERIAL

65-67 3.3.4.6 NO RECOVERY
16 0.0

70-72 3.3.5.7 DK GRN GRY (5G4/1) SILTY, F. SAND
17 0.7 TRACE ~~SOME~~ SHELL FRAGS

75-77 2.2.3.6 SAA
18 2.0

80-82 3.4.5.9 MOD. OL BRN, SLIGHTLY PLASTIC.
19 SANDY SILT + F. SAND TO SANDY SILT
(MARL)

8/17/[illegible] SUNNY + HOT

0700 - [illegible] FOX ONSITE

0705 - [illegible] ONSITE
[illegible] SAFETY MEETING

0720 - [illegible] TO GET ANOTHER PALLET
[illegible]

0725 - RUN RODS INTO HOLE + ADVANCE
TO 80'

0805 - TAKE COLLECTING 80-82' SAMPLE FROM GT-0[illegible]

0815 - [illegible]
CLEAN OUT MUD TUB
BREAK DOWN RODS

0815-0835 WAIT FOR [illegible] TO RETURN

0835-0845 [illegible] GETS H_2O

0845 BEGIN MIXING GROUT

0900 FINISH GROUTING BORING TO SURFACE

0925 - [illegible] ONSITE TO MOVE DRUMS
- [illegible] + KIM
- MOBE TO GT-03

1130 - FINISH SAMPLING GT 03 TO 77'
- CLEAN OUT MUD PAN
- GET H_2O
- GROUT BORING

1200 - LUNCH

1320 SETUP ON GT-06 + BEGIN SAMPLING

1515 - [illegible] STOPS MOVING DRUMS

1518-1538 SHUT DOWN [illegible] OF [illegible]

1635 - COLLECT 90-92' SPOON FROM GT-06
- BREAK DOWN RODS
- CLEAN OUT MUD TUB
- PREP TO GROUT

1710 - GROUT BORING TO SURFACE
CLEAN UP SITE
MOBE TO GT-05

1745 - DRILLERS DEPART

1800 - [illegible] DEPARTS

8/20/97 GT-05

65-67 4 4.5.5 DK GRN GRY (5G 4/1) SLIGHTLY
15 0.25 PLASTIC SILTY CLAY

70-72 3.4.2.4 70-71.35 SAA, CLAYEY, F-C SAND
16 2.0 SOME SHELL FRAGS, SAT
71.35-72 SAA, CLAYEY, F SAND, SAT
ROTTEN EGG ODOR FOR WHOLE SAMPLE

75-77 B 1.1.2.10 15 76.25 SAA
17 2.0 76.25-77 MOD. OL. BRN, SLIGHTLY PLASTIC
SANDY SILT (MUD)

GT-06

60-62 3.5.4.5 DK GRN GRY (5G 4/1), CLAYEY,
16 1.4 F SAND, TR. SHELL FRAGS, T
ROOTED, SAT
65-67 1.4.4.5 65-66.35 SAA, SANDY CLAY
17 1.6 66.35-67 SAA F SAND, SOME CLAY
70-72 2.7.10.11 70-71.4 SAA
18 1.5 71.4 MOD OL BRN SILTY F SAND
75-77 2.3 4.5 75-76 DK GRN GRY (5G 4/1) F SAND
19 2.0 SOME CLAY TR SHELL FRAGS
76-77 SAA SILTY CLAY, TR F SAND
80-82 4.5.7.17 MOD OL BRN, SANDY SILT, SLIGHTLY
20 2.00 PLASTIC
85-87 4.4.4.6 SAA
21 2.0
90-92 3.4.6.6 SAA
22 2.0

8/21/97 MOSTLY SUNNY

0700 - [illegible] FOR [illegible]

0720 - DRILLERS ARRIVE

[illegible] SAFETY MEETING

0730 - [illegible] TO SAMPLE GT-04

0815 - [illegible] FOR MORE [illegible] BRK

0900 - W. MURDOCK (SCEA[illegible]) ONSITE TO CONTINUE MOVING [illegible]

0930 - [illegible] W/ [illegible]

1000 - FINISH SAMPLING GT-05 TO 82'. PREPARE [illegible]

1050 - FINISH GROUTING + CLEANING UP @ GT-05 MOVE TO GT-04

1110 - BEGIN ADVANCING ~~[illegible]~~ GT-04

1155 - FINISH ADVANCING RODS TO 70'

- TAKE LUNCH

- ETF MEASURES DIMENSIONS FOR MW-33 LOCATION

- TALK W/ M. BRENNAN + RON [illegible]) ABOUT BEST PLACE TO INSTALL WELL [illegible]

- INSTALL EITHER IN S. WEST CORNER OR NEXT TO WATER BOX

- BEST TIME WOULD BE @ 08:00

1310 - DRILLERS BEGIN PULLING AND CASING TO COLLECT THE SAMPLE FROM 70-72

8/21/97

1440 - WINCH CABLE BEGINS TO UNRAVEL. MUST LOWER MAST + [illegible] BAD SECTIONS

1550 - CONTINUE DRILLING

1720 - FINISH SAMPLING TO [illegible] PREP TO GROUT

1800 - FINISH GROUTING + CLEANING [illegible]

- [illegible] TO [illegible]

- [illegible]

8/21/97

CT-05

65-66	2.3.6.8	DK GRN GRY (5GY 4/1) SANDY	
16	2.0	CLAY TRANSITIONAL TO SANDY F SAND	
70-72	2.4.5.7	70-71	SAA / CLAY SOME F SAND
17	2.0	71-72	SAA, F SAND SOME CLAY SOME TRACE SHELL FRAG
75-77	3.3.4.5	SAA CLAY + F SAND	
18	2.0		
80-82	2.7.7.8	MOD OL BRN, SANDY, SILTY	
19	2.0	SLIGHTLY PLASTIC	

CT-04

8/21/97

65-66	3.2.2.4	65-66.35 A DK GRN GRY (5GY 4/1) SILTY CLAY
16	1.6	SOME SHELL FRAGS
		(66.35-67 SAA, SILTY F SAND)
70-72	2.4.5.7	SAA, GRAVEL (SILT), SOME F SAND
17	2.0	SCATTERED, SLIGHTLY PLASTIC
75-77	2.2.4.6	SAA
18	2.0	
80-82	1.2.5.6	SAA SILTY F SAND SOME SHELL FRAGS TRACE MED. SAND
19	2.0	
85-87	5.5.5.6	MOD OL BRN, SLIGHTLY PLASTIC
20	1.8	SILT, SOME SAND
90-92	11.15.20.21	SAA
21	2.0	
95-97	3.4.6.7	
22		

APPENDIX D
REPORT OF GEOTECHNICAL EXPLORATION

REPORT OF GEOTECHNICAL EXPLORATION

AQUARIUM PARKING GARAGE
CHARLESTON, SOUTH CAROLINA
S&ME JOB NO. 1131-97-290

Prepared For:

FLUOR DANIEL GTI
EAST PITTSBURGH, PENNSYLVANIA

Prepared By

S&ME, Inc.
840 Low Country Boulevard
Mt. Pleasant, South Carolina

September 24, 1997

TABLE OF CONTENTS

EXECUTIVE SUMMARY

A subsurface exploration was performed in order to determine various geotechnical parameters for use in the design of the proposed Aquarium Parking Garage in Charleston, South Carolina. Our conclusions and recommendations can be summarized below:

1. Subsurface conditions at the site were explored by drilling seven soil test borings to depths of 10 to 97 ft below existing grade. Due to on-site contamination from previous industrial facilities on and around the site, extensive casing and soil containerization was required.

2. The borings encountered a variety of sand and clay soil strata that varied in consistency and thickness. Three strata are of particular importance; 1) 6 to 10 ft of uncontrolled fill (sand with bricks, concrete, wood, etc.) near the surface, 2) a thick (typically 35-ft) very soft, highly plastic clay beneath the fill, and 3) the Cooper Marl, a soft to hard sandy silt that was encountered at about 80 ft below grade.

3. We recommend a seismic site coefficient (S) of 1.5 for seismic design, based on soil type S_3. Sand deposits within the fill (upper 6 to 10 ft) and between 45 and 55 ft at the site may liquefy during a seismic event.

4. A deep foundation system will be required to support the proposed structure. A foundation system consisting of driven piles (12-in. and 14-in. square prestressed concrete piles and steel H-piles) was the only option considered. We believe that auger cast piles and/or drilled caissons are probably prohibitive due to contaminants in the soil.

5. The first floor slab, if earth supported without ground modification, may settle 6 in or more due to the placement of 2 ft of new conventional fill at the site. One option to eliminate this settlement is to structurally tie the slab into the piles. Another option is to fill the site with lightweight fill or a combination of lightweight and conventional fill to reduce the load induced by the fill. A third option is to surcharge the site. Flexible asphalt paving could be used within the first floor area although periodic maintenance would eventually be required to repair settlement related problems. Alternatively, a ground modification program (surcharging with/without the use of lightweight fill) could be used to reduce post construction settlement.

1.0 PROJECT INFORMATION

We understand the proposed parking garage will be a six-level, reinforced concrete structure with a footprint of 180 ft x 365 ft. Based on Walker Parking Consultant's fax to Sandy Logan dated April 29, 1997, we anticipate column loads for the structure will be in the range of 500 to 1200 kips. We understand that the desired elevation of the first garage level will be near present grades, but as subsequently explained, we have assumed that up to 2 ft of controlled fill will be required underneath the first floor slab.

As a result of its industrial past, the site has been classified as contaminated. Specifically, the upper aquifer and soils contain hazardous and potentially hazardous levels of chemicals of concern. As explained subsequently, the contamination required special drilling procedures. Also, in consideration of the cost of disposing of any of the soils from the site, we have assumed that any construction activity involving excavation will be prohibitively expensive. Therefore, our subsequent geotechnical evaluation has not considered construction techniques such as undercutting, drilled shafts, auger cast piles, etc.

2.0 EXPLORATION PROCEDURES

2.1 FIELD DRILLING AND TESTING

Subsurface conditions at the site were explored by drilling seven soil test borings (designated GT-1 through GT-6, and GT-1A) within the footprint of the structure. The approximate boring locations are shown on the Boring Location Plan (Fig. A-1) enclosed in the Appendix. Boring GT-1 was terminated at 10 ft due to obstructions. The other six borings were drilled to a depths of 77 to 97 ft. The boring locations were established in the field by pacing distances and estimating right angles from existing site features, and should therefore be considered approximate. Standard Penetration Tests (ASTM D-1586) and split-spoon samples were generally obtained continuously in the upper 8 to 10 ft of the borings (except GT-2 which was continuously sampled to 16 ft) and at 5-ft intervals thereafter.

Due to the on site contamination in the upper soils, extensive casing was required to reduce the chance of the contaminants migrating to deeper soil strata. In general, the borings were drilled to depth of 15 ft. An 8 in. casing was then set to a depth of approximately 20 ft and grouted. This grout had to cure for at least 24 hours before drilling within the boring could continue. The borings were then advanced to a depth of approximately 60 ft and a 4 in. casing was "telescoped" through the 8 in casing. Again, the 4-in. casing was grouted and allowed to cure for at least 24 hours before the borings were advanced to their termination depths. A more detailed description of our field testing procedures, as well as the Boring Logs, are included in the Appendix of this report.

2.2 LABORATORY TESTING

In order to evaluate the liquefaction potential of sands three grainsize analyses were performed on select samples. Consolidation properties of clay strata were evaluated

through one consolidation test, eleven moisture content tests, and three Atterberg Limits tests. These test results are provided in the Soil Data Summary, the consolidation test report, and on individual boring logs included in the Appendix of this report.

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 SITE CONDITIONS

The site is located on the eastern side of peninsular Charleston within the southern half of the property bounded to the north by Charlotte Street, to the west by Washington Street, to the south by Calhoun Street, and to the east by Concord Street. Most of the relatively level site was previously occupied (in the late 1800's) by a wood treating plant which used creosote during it's manufacturing process[1]. A former manufactured gas plant was also located adjacent to the site between the 1850's and 1950's. The site is presently closed and fenced off (June 1999), but includes a former baseball field, basketball court, and picnic shelter. The site is located approximately 500 ft to the west of the Cooper River and contains numerous ground water monitoring wells.

3.2 SUBSURFACE CONDITIONS

Details of the subsurface conditions encountered by the soil test borings are shown on the Boring Logs in the Appendix. A subsurface profile of these conditions is illustrated on Figure A-2, which can be found in the Appendix. The logs and profile represent our interpretation of the subsurface conditions based upon visual examination of the split-spoon samples. Stratification lines on the Boring Logs and profiles represent approximate boundaries between soil types; however, the actual transition may be gradual.

[1] RI Report, Fluor Daniel GTI, 1996

The general subsurface conditions and their pertinent characteristics are discussed in the following paragraphs.

1. Fill (sand, gravel, brick, concrete, wood): Very loose to medium dense, or soft to firm fill material was encountered in all seven soil test borings to a depth of about 6 to 10 ft. The fines content throughout the fill varied greatly. The Standard Penetration Test (SPT) N-values ranged from 2/18" to 50/6" and were obviously effected by debris (brick fragments, etc.). A moderate to strong organic (and chemical) odor was detected within much of the fill.

2. Clay (CH): This very soft to stiff, highly plastic soil was encountered between depths of approximately 8 to 45 ft below existing grade. SPT N-values of these clays ranged from less than 1 (wor-weight of drilling rods) to 2. The water content within this zone ranged from 73% to 126 %, but was generally about 95%. The grain-size analysis run on one sample indicates a fines content of 94%.

3. Clayey Sand (SC) and/or Silty Sand (SM): This 5 to 15 ft thick, very loose to medium dense, clean to clayey and/or silty sand, was encountered at depths ranging from about 40 to 60 ft. In several borings, this sand strata contained zones which were very clayey. SPT N-values ranged from 3 to 20. Three moisture content determination tests were conducted on samples from this zone and indicated a water content of 29 to 33 percent. Fines contents of two samples were 18 and 19 percent.

4. Clay (CH/MH): Between approximately 55 and 70 ft, the borings generally encountered a soft to stiff, slightly sandy to sandy, highly plastic clay. SPT N-values ranged from 3 to 15. The moisture content ranged from 49 to 65 percent. Two Atterberg limits tests were run on samples from within this strata, which resulted in liquid limits of 86 and 104 and plasticity indices of 57 and 65, respectively.

5. Very Sandy Clay/Very Clayey Sand (SC/CH): Between approximately 70 ft and the top of the Cooper Group (Cooper Marl), the borings generally encountered soft to stiff (3 to 9), very sandy clay or very loose to medium dense (4 to 17), very clayey/silty sand. Laboratory testing was not performed on any samples taken from this zone.

6. Cooper Group (Cooper Marl) - Sandy Silt (MH)/Silty Sand (SM): This olive, calcareous, soft to hard sandy silt material and/or loose to medium dense silty sand, which is locally referred to as Cooper Marl, was encountered in the six borings at a depth of 76 to 84 ft below existing grade. All deep borings were terminated within the marl at depths of 77 to 97 ft. The SPT N-values ranged from 4 to 35. The total thickness of this soil stratum is generally in excess of 100

ft. The Cooper marl is the thick "basement" strata of the area in which most deep foundations bear.

Groundwater levels were measured at the time of drilling and varied from 1½ ft to + ft below existing grade. However, groundwater levels will fluctuate with seasonal and climactic variations, tidal fluctuations, and construction activity in the area.

4.0 CONCLUSIONS AND RECOMMENDATIONS

The analyses and recommendations submitted herein are based, in part, upon data obtained from the subsurface exploration. The nature and extent of variations between the borings will not become evident until construction. If variations appear evident, then we will re-evaluate the recommendations of this report. In the event that any changes in the nature, design, or location of the building are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions modified or verified in writing. We strongly recommend that S&ME be retained to review the final design plans and specifications to confirm that earthwork and foundation recommendations are properly interpreted and implemented.

4.1 SEISMIC CONSIDERATIONS

As stated in Section 1206 of the Standard Building Code, "Every building and structure, and portion thereof, shall be designed and constructed to resist the effects of earthquake motions....". The remainder of Section 1206 specifies how the seismic loading is to be estimated and analyzed for a given site. Since the Charleston area is within a known seismically active region, earthquake loads are an important part of the design process.

4.1.1 Seismic Site Coefficient

Based upon the Standard Building Code (1992/1993 Revisions), the site soil conditions can be classified as Soil-Profile Type S_3:

> "A soil profile containing 20 to 40 ft in thickness of soft to medium-stiff clays with or without intervening layers of cohesionless soils."

A Seismic Site Coefficient (S) of 1.5 is therefore appropriate for design.

4.1.2 Design Earthquake For Liquefaction Analysis

The Standard Building Code (1992/1993 Revisions) requires that the design earthquake have a 90% probability of non-exceedance in 50 years. To satisfy this criteria, the design earthquake used in our analyses has a magnitude (M) of approximately 5.9, and produces a "base" acceleration of 0.12g. This is the seismic event being used in the design of the I-526 (Mark Clark Expressway) bridges over the Stono River, which was developed by a comprehensive study of Charleston seismicity. S&ME commissioned Martin C. Chapman[2] to perform this study in 1992, during the early design stages for the Mark Clark project. Depending on actual near surface stratigraphy, the base acceleration may be amplified within the overlying soils. Theoretical determination of the site amplification was beyond the scope of this study. However, based upon complete site seismic response analyses we have conducted on similar sites, and upon empirical relationships for the amplification of base acceleration due to site specific soil conditions, we have assumed that the Peak Ground Acceleration (PGA) will be 0.18g. This acceleration value has been used in our liquefaction analysis.

4.1.3 Liquefaction Potential

Liquefaction, which is the loss of a soil's shear strength due to the increase in porewater pressure resulting from seismic vibrations, is always a concern in the Charleston area. Liquefiable soils are found in the Charleston area and significant geological evidence suggests liquefaction has commonly occurred during past earthquakes. Soils most susceptible to liquefaction generally consist of saturated, loose, "clean" (i.e., plasticity index of less than 5), fine (10% size ranging from 0.07 to 0.25 mm) sands. Various zones within the sand fill (upper 10 ft) and several sand layers between 45 and 55 ft meet this criteria.

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[2] Martin C. Chapman is a seismologist at the Seismological Observatory of the Virginia Polytechnical Institute.

Liquefaction potential was evaluated with the widely-used methods developed by Seed, Idriss and Arango[3] which are based on field observations of the performance of sand deposits during previous earthquakes. This method compares some in-situ characteristics of the observed liquefiable deposits to the actual deposits at the subject site. This liquefaction analysis procedure is widely accepted by government agencies, and is described in NAVFAC Design Manual 7.3.

For each stratum which appeared to meet the previously outlined grainsize and plasticity criteria, a factor of safety against liquefaction was calculated using the procedures outlined by Seed, et al. This factor of safety is the ratio of the cyclic stress required to cause liquefaction to the cyclic stress generated by the design earthquake. Subsurface strata with a factor of safety against liquefaction of less than 1.2 are generally considered to be "liquefiable". Our results indicate that a few isolated sand zones within the upper 10 ft (fill zone) and the sands at a depth of approximately 50 ft are liquefiable.

With regard to foundations and building construction, liquefaction creates two major problems; ground-surface disruption and/or volumetric compression. Ground surface disruption may be in the form of fissures, sand boils, surface oscillations or lateral displacements. Such ground surface disturbances could result in catastrophic failures such as "punching" failures of foundations supported above the liquefiable deposits.

Based on recent work by Youd and Garris[4], the presence of a sufficiently thick (> 3 meters) layer of non-liquefiable soils over liquefiable sands will prevent ground disruptions. Across the majority of the site, non-liquefiable soils (including an assumed

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[3] Seed, H.B., Idriss, I.M., and Arango, I., "Evaluation of Liquefaction Potential Using Field Performance Data," Journal of Geotechnical Engineering, ASCE, Vol. 109, No. 3, Mar., 1983, pp. 458-482.

[4] Youd, T.L., and Garris, C.T., "Liquefaction - Induced Ground Surface Disruption," Journal of Geotechnical Engineering, ASCE, Vol. 121, No. 11, November, 1995, pp. 805-809.

2-ft layer of new fill) which overlie the liquefiable sands appear to be sufficiently thick to prevent extensive ground surface disruption.

Because of the heavy structural loads of the garage, a deep foundation system will be required. Our subsequent recommendations for deep foundations take into account the presence of these liquefiable deposits. Therefore, the only structural elements at risk to liquefaction induced volumetric compression settlement are slabs-on-grade, retaining walls, planters, etc. Prediction of the magnitude of this settlement is very difficult. However, based upon currently available methods, we estimate that settlement due to liquefaction induced volumetric compression could be as much as 2 to 5 in.

4.2 FOUNDATION RECOMMENDATIONS

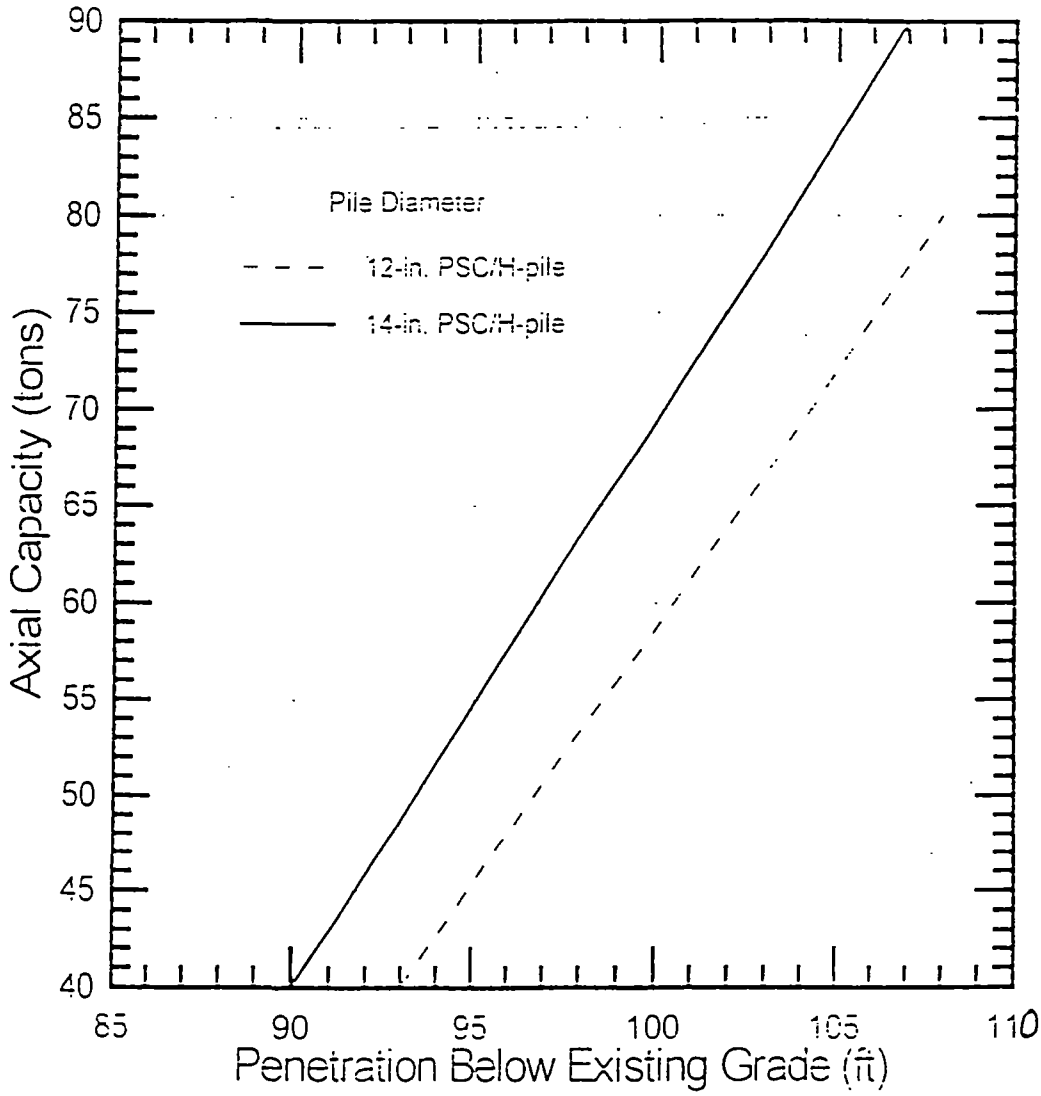
The thick deposits of weak, compressible soils will not be capable of supporting the required foundation loads on spread footings. Therefore a deep foundation system bearing in the Cooper Marl will be required. However, we have evaluated the possibility of "earth supporting" the relatively lightly loaded first floor slab near existing grade. Our evaluations and recommendations are summarized in the following sections.

4.2.1 Deep Foundations

We have limited our deep foundation evaluation to only driven piles (pre-stressed concrete and steel H-piles). We assume that auger cast piles and/or drilled caissons are prohibitively expensive due to economic issues related to the contaminants in the soil. The local cost of transporting and incinerating contaminated (but not hazardous) material is on the order of $50 per ton.

Axial Capacity. Estimates of the ultimate compressive capacity of 12-in. and 14-in. square, prestressed concrete piles and steel H-piles bearing in the Cooper Marl are

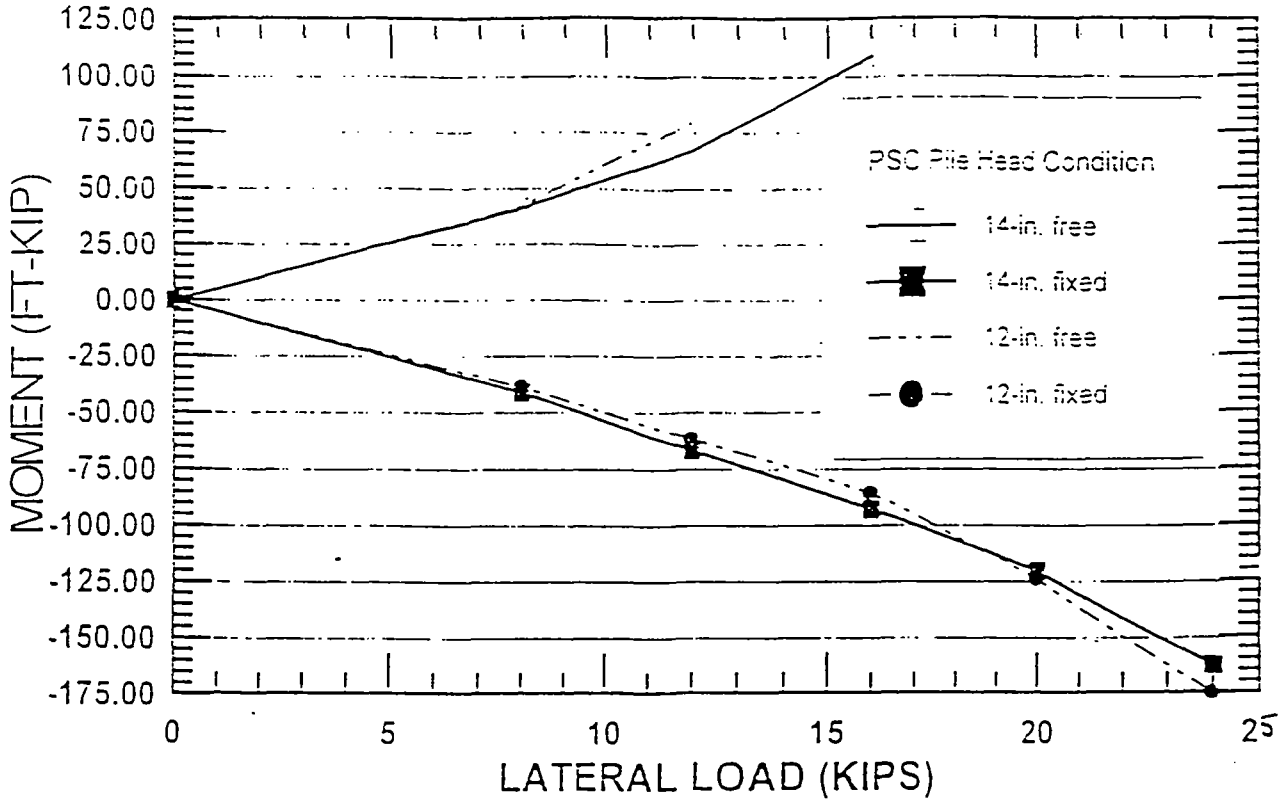
AQUARIUM PARKING GARAGE
Allowable Axial Pile Capacity Vs. Penetration Below Existing Grade (12-in. and 14-in. PSC/H-pile)

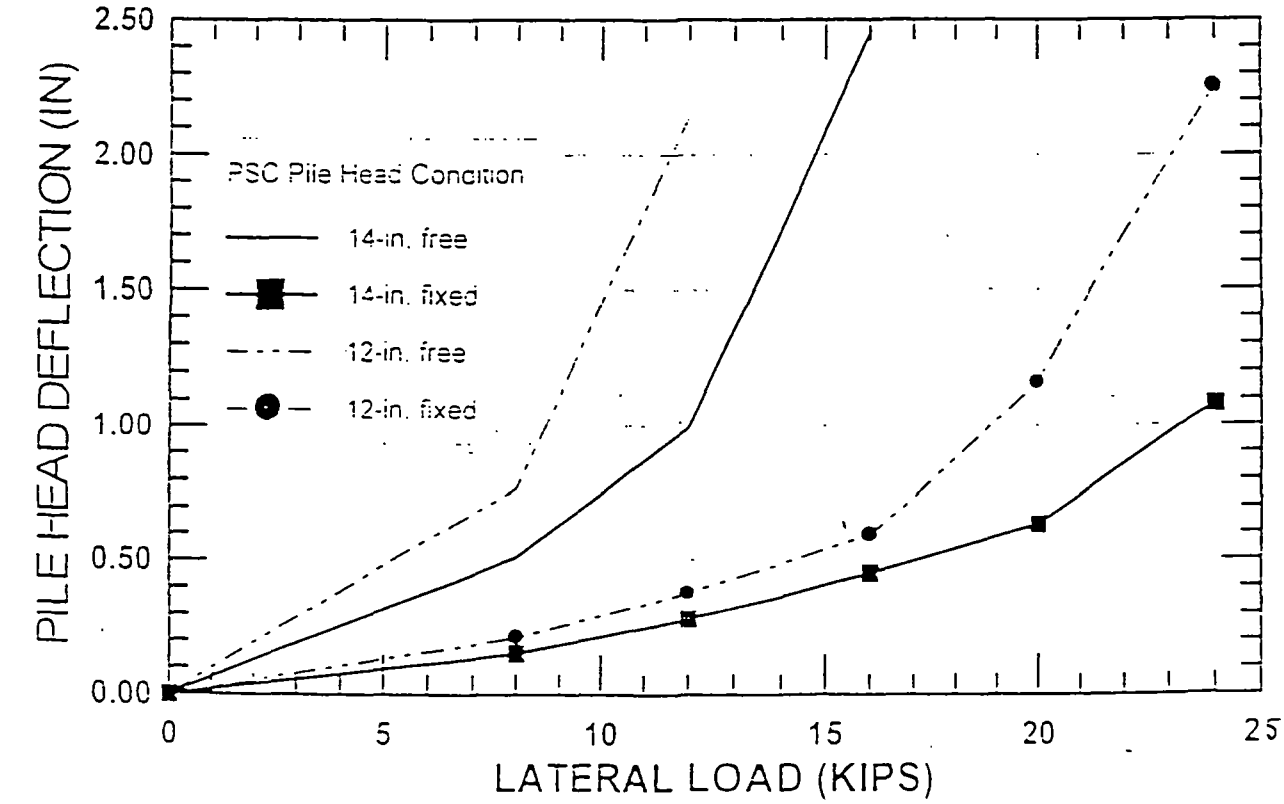


Notes
1) Minimum center to center pile spacing assumed to be five pile diameters
2) An efficiency factor of 1.0 should be used for center to center pile spacings of 5 pile diameters or more and decrease linearly to 0.8 at 3 pile diameters. Pile spacing should not be less than 3 pile diameters
3) Allowable tensile capacities for driven piles are 50% of the compressive capacity
4) The structural capacity of the pile has not been considered in our analysis
5) Analysis assumes the Copper Marl is located at a depth of 80 ft below existing grade

Job No : 1131-97-292	S&ME	Allowable Compressive Capacity Driven 12-in. and 14-in. Piles Aquarium Parking Garage Charleston, South Carolina	Figure No 1
Date : September 19, 1997			
Not to Scale			

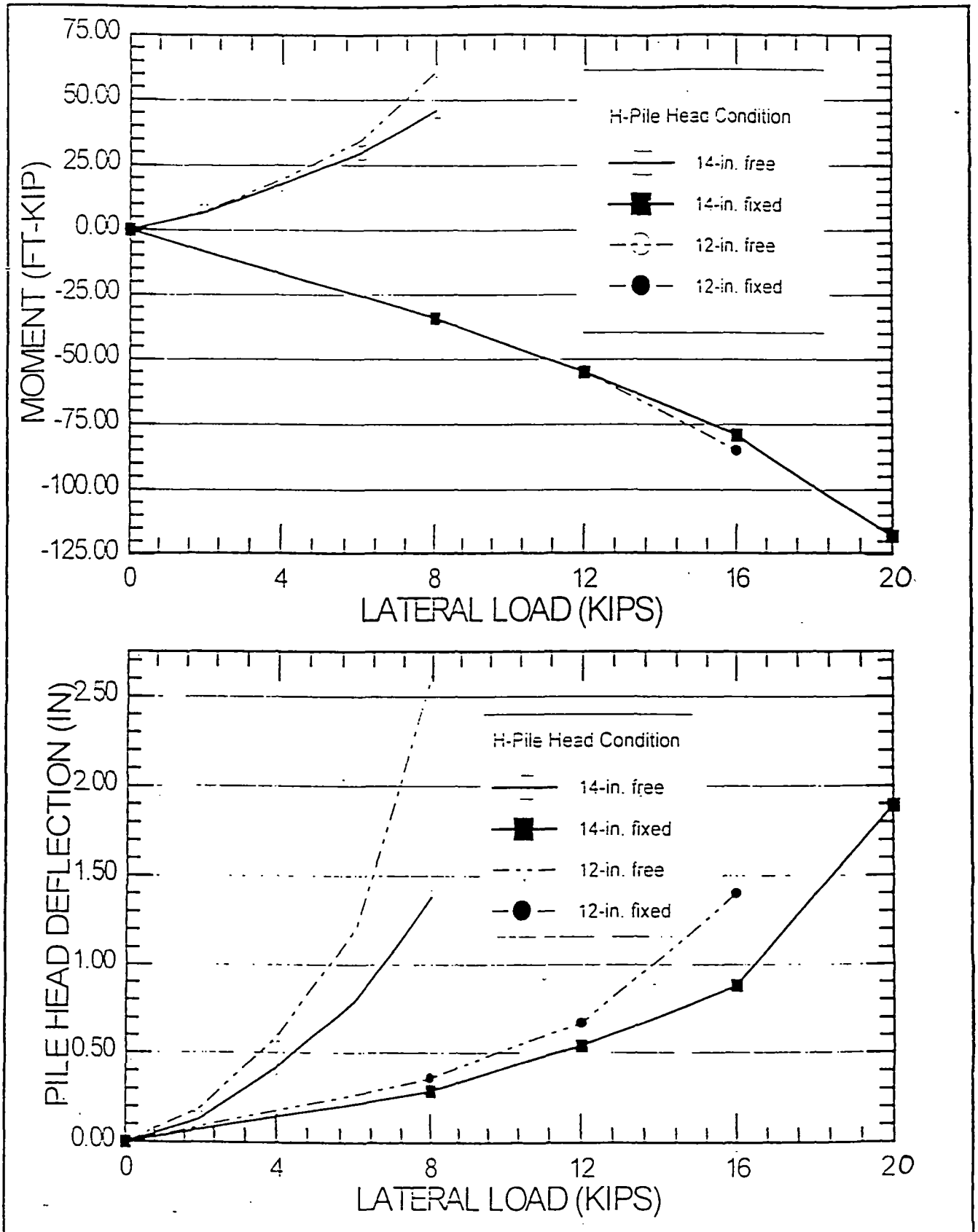
Lateral Foundation Analyses. The effects of lateral loading on the 12 and 14 in. PSC/H-piles were estimated using the finite difference computer program LPILE Plus. This program models soil behavior with the use of p-y curves to estimate pile deflection and bending moment based on various pile sizes, soil conditions and loads. Our analyses assumed all lateral loads are applied at ground surface, and that center-to-center pile spacings are at least 5d. Figures 2 and 3 graphically presents our estimates of lateral load versus deflection and internal bending moment for single piles with an 80 ton axial load. Fixity, defined as the first inflection point of the pile displacements, occurs about 20 ft below the pile head for all four pile types that were considered.





Notes
1) 12-in. and 14-in. PSC piles analyzed using a 80 ton axial compressive load
2) Analysis conducted on a single pile. analysis does not account for group effects
3) Lateral load applied at ground surface
4) The structural capacity of the piles was not considered in this analysis

Job No : 1101-97-091	S&ME	Lateral Pile Analysis Driven PSC Piles Aquarium Parking Garage Charleston, South Carolina	Figure No 2
Date : September 19, 1997			
Not to Scale			



Notes 1) 12-in and 14-in H-piles analyzed using a 80 ton axial compressive load.
2) Analysis conducted on a single pile analysis does not account for group effects
3) Lateral load applied at ground surface.
4) The structural capacity of the piles was not considered in this analysis

Job No.: 1131-97-290	S&ME	Lateral Pile Analysis Driven H-Piles Aquarium Parking Garage Charleston, South Carolina	Figure No. 3
Date: September 19, 1997			
Not to Scale			

Pile Installation. Based on our experience with similar projects, drop, air or diesel hammers having rated energies in the range of 30 to 60 ft-kips should be suitable for the pile installation. However, the dense sand layers above the marl could cause some driving difficulties. Ordinarily, such sands would be pre-augered as necessary. Since pre-augering should be avoided due to site contamination, a larger hammer may be required. For this reason, steel piles (which will penetrate the dense sands easier) may be a better alternative, although they are typically more expensive than concrete piles. Consequently, the selection of a suitable driving system may have to be made based on the results of the test pile program. If pre-augering is required, and appears economically feasible, it should be limited to a depth of 80-ft. The diameter of the auger should be equal to the least dimension of the pile (i.e., 12 in. or 14 in., respectively, for 12 in. and 14 in. piles).

A review of historical maps indicates that the site is located in an area of original Cooper River marshland. Based upon the results of our borings, it appears that the site has been filled in the past and consequently, significant obstructions to pile installation may be encountered within the upper 10 ft. Typically, this relatively common problem is overcome by pre-augering or pre-excavation with a track-hoe. If pre-augering or digging is too expensive, a steel spud may be required to displace debris and create pilot holes through the uncontrolled fill. Again, the feasibility of this method will be best evaluated during the pile test program. Also, such concerns may make steel piles a better alternative.

Pile Vibrations. It does not appear that there are any structures in the immediate vicinity to the parking garage which would sustain damage as the result of vibrations induced by pile driving. However, it may be prudent to perform a pre- and post-construction survey in order to monitor the affects of pile installation on the surrounding areas. This survey should include video and photographic documentation as well as the installation of crack monitors throughout the area. In addition, we recommend that vibration monitoring be performed during initial pile installation.

4.2.2 FIRST FLOOR SLAB

Fill Placement and Settlement. We understand that if possible, the first floor slab will be non-structural and constructed at or just above present grade. Based on our borings, we anticipate that such plans may require extensive undercutting. After removal of surficial organic material (topsoil), uncontrolled fill (bricks, wood, concrete, etc.) may be encountered. Much of this debris may have to be removed to provide a stable subgrade. Due to environmental concerns, we assume that such undercutting should be avoided. The undercutting could be avoided provided that the uncontrolled fill is covered by a minimum of 2 ft of compacted controlled fill (described in subsequent paragraphs) beneath pavements and slabs. However, this fill placement will cause settlement.

Like much of peninsular Charleston the site was filled in the past, probably as much as 100 years ago. The very soft marine clay which was encountered beneath this fill (between depths of approximately 8 and 40 ft) is highly compressible, and will consolidate with even small stress increases (such as the weight of the 1 to 2 ft of new fill). Clays consolidate (causing surface settlement) as water is expelled from the voids in the soil. This process is extremely slow, particularly in this case where the clay stratum is very thick, and consolidation can continue for many decades. Based on their high natural moisture contents (73% to 126%), the clays at this site may still be consolidating under the weight of the 6 to 10 ft of existing fill.

Structures (i.e., a non-structural parking slab) supported above these clays will settle as the clays consolidate. The prediction of the rate and magnitude of any remaining consolidation due to the existing fill loads is extremely difficult. However, it is possible that some additional long-term settlement (probably < 1 in.) may occur. It is important to note that this settlement will occur even if no additional load is added to the soil. Settlement will be much greater assuming 2-ft of fill will be required, as discussed previously.

The addition of 2 ft of fill under a non-structural parking slab will cause the soft clays to consolidate. Based on the consolidation test and moisture content test data, we estimate that the long-term consolidation settlements due only to fill placement will be on the order of 6 in. or more. This again is in addition to the settlement which is probably still occurring from the placement of the original fill.

If the loading is reduced, the settlement will be reduced. Obviously, one option is to construct the first floor parking deck as a structurally supported slab. Another option is to use lightweight or engineered fill, thereby reducing the load and resulting settlement. Several types of lightweight fill are available. These include pumice stone mined in Greece and marketed by Tarmac America, Inc. This material, slightly larger than pea gravel, is currently being used on a road construction project in North Charleston. Other examples include Solite (expanded shale) and Elastizell (all with unit weights of 30 to 55 pcf). These materials may be combined with earthen fill in order to reduce costs. Reduction of the average soil density to less than 40 pcf with the use of lightweight fill may reduce total settlements resulting from fill loads to less than 3½ in.

A third option is to preconsolidate the site by surcharging. A surcharge program consists of placing an additional quantity of temporary fill over the required permanent fill. The additional fill increases the stress on the compressible soil, thereby speeding consolidation. Once the compressible soils have consolidated to a point where further settlement due only to the weight of the permanent fill is within tolerable limits, the surcharge is removed. The greater the surcharge, the sooner the surcharge may be removed. However, drainage distance is another controlling factor with regard to consolidation time. Due to the relatively large thickness (40 ft) of the clay layer, measures to speed consolidation by reducing the drainage distance must be considered. Wick drains are typically the most cost-effective method of decreasing drainage distance and shortening the consolidation time. (Wick drain costs are typically about $0.50 per lineal ft. installed).

Various combinations of surcharge height, surcharge time, and wick spacing are presented in Table 1. All scenarios assume a permanent fill height of 2-ft.

Table 1

SURCHARGING OPTIONS

Fill Height (permanent and surcharge)	Surcharge Time	Wick Spacing	Assumed Wick Cost*	Remaining Settlement Due to Fill
6 ft	180 days	7 ft	$42,000	2½ in.
6 ft	180 days	5 ft	$83,000	½ in.
6 ft	90 days	5 ft	$83,000	2½ in.
8 ft	180 days	9 ft	$26,000	2½ in.
8 ft	180 days	7 ft	$42,000	1 in.

* Wick cost estimate based on 50 ft long wicks, spaced in a triangular pattern over a 190 ft by 375 ft area at $0.50/ft. Does not include cost of mobilization.

To monitor the rate and magnitude of site settlement we recommend that settlement plates be installed at several locations within the garage footprint. A sketch of a typical settlement plate arrangement is shown in Figure A-3 of the Appendix. Protection (from any movement) of the settlement plates during construction is imperative. Fill soils should be methodically hand placed and compacted in areas above and immediately surrounding the settlement plates. Fill soils should not be dumped in the immediate areas of the settlement plates. Settlement plate locations should be barricaded after completion of filling to prevent the plates from being disturbed of destroyed. Upon completion of controlled fill placement, the site should be allowed to consolidate until settlement plate data, as interpreted by a geotechnical engineer, indicates post construction settlement due to the permanent fill will be within tolerable limits. Accurate surveying of the elevation of the plates should begin immediately after their installation and continue weekly for the first four weeks and then bi-weekly thereafter.

4.3 SITE PREPARATION

As mentioned previously, typical site preparation will likely be modified due to the containation within the upper soils. Based on the results of the borings, we anticipate that extensive undercutting will be required. However, due to the contaminants in the soil, and the thickness of the uncontrolled fill (6 to 10 ft), we assume that undercutting will be prohibitively expensive. Foreign debris such as uncontrolled fill (bricks, wood, etc.) was encountered within all seven borings. Typically, any debris encountered must be completely removed to depths necessary to provide a minimum of 2 ft of compacted, controlled fill beneath pavements and slabs. After stripping, areas at grade to receive fill are generally proofrolled with a fully loaded tandem-axle dump truck or similar equipment to detect any unstable areas. Any areas which pump or rut excessively are scarified and densified in-place, or undercut and replaced with soil subsequently described as controlled fill. At this sire, we recommend that only surficial organic material (topsoil) be removed and the exposed subgrade (which will typically contain uncontrolled fill) receive a minimum of 2 ft of controlled fill. Areas which receive controlled fill should be proofrolled with a to detect any unstable areas.

4.4 CONTROLLED FILL

Controlled fill material should be cohesionless soil containing no more than 10% fines (material passing the No. 200 sieve) by weight and having a maximum dry density (ASTM D-1557) of at least 100 pcf. The soil should be free of organics, deleterious matter and elongated or flat particles which may be susceptible to degradation. The fill should be placed in uniform lifts of 10 inches or less (loose measure), and compacted to at least 95% of the modified Proctor maximum dry density (ASTM D-1557).

4.5 CONSTRUCTION MONITORING AND TESTING

Random in-place density testing should be performed on all fill by an experienced engineering technician to determine whether the specified compaction has been achieved and if the fill material meets specified requirements. Fill subgrade evaluations and proofrolling and undercutting operations should performed by a geotechnical engineer or their representative.

Test Pile Program. The environmental contamination and poor soil conditions of this site combine to make foundation construction complicated and potentially difficult. Pre-augering and shallow excavation should ideally be avoided due to environmental costs yet the dense, deep sands and near surface debris may interfere with pile driving. Additionally, the elevation of the bearing stratum (Cooper marl) varies by as much as 8-ft across the site and the thick compressible strata makes down drag a concern. Finally, the depth of the bearing stratum and the structural loads will result in relatively long piles. The uncertainties associated with these factors can substantially increase the cost of the foundation. An elimination or reduction of these uncertainties can result in significant savings. For example, the use of steel piles would alleviate many of the pile drivability concerns. However, due to the large difference in material costs, substantial savings will be realized if the prestressed concrete piles can be driven. Therefore, a thorough pile load test program is warranted. Furthermore, the saving will be maximized if the testing is performed prior to construction. The results of the testing will then be available for the final bid documents. This approach was used with great success during the design/construction of the Charleston County Health Complex Parking Garage.

Pile capacities should be verified at the start of construction through static pile testing and dynamic testing with a Pile Driving Analyzer™ (PDA) in accordance with ASTM D-1143 and D-4945. We recommend that eight probe piles be driven at production pile locations across the site. Four of the probe piles should be prestressed concrete and

four should be steel. A steel pile should be driven at a location close to each of the four concrete piles such that drivability can be better evaluated. One of the pile pairs should be driven in the vicinity of GT-4 since the marl was deeper in this boring.

After installation, the piles should be dynamically monitored during restrikes. We recommend restrikes be performed 3 to 7 days after driving. At least one of the concrete piles should be statically loaded to failure, or to a minimum of three times the design load, using the "quick load test method" of ASTM D-1143 - Standard Method of Testing Piles Under Static Axial Compressive Load. The static test pile should be instrumented with electronic strain gauges to develop load transfer data for the overburden soils. The load transfer data will be used to evaluate negative skin friction potential. After an evaluation of the dynamic and static load test data, production pile lengths and capacities can be established. Additionally, the installation of all driven piles during production should be monitored by an engineering technician working under the direction of a geotechnical engineer.

A pre- and post-construction survey of the surrounding buildings should be performed in order to document any damage associated with the installation of driven piles. This survey should include video and photographic records and the installation of crack monitors throughout the area. We also recommend that vibration monitoring be performed during pile installation.

5.0 LIMITATIONS OF REPORT

This report has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to this project. The conclusions and recommendations contained in this report are based upon applicable standards of our practice in this geographic area at the time this report was prepared. No other warranty, expressed or implied, is made.

APPENDIX

FIGURE A-1: BORING LOCATION PLAN

FIGURE A-2: SOIL PROFILES

BORING LOGS

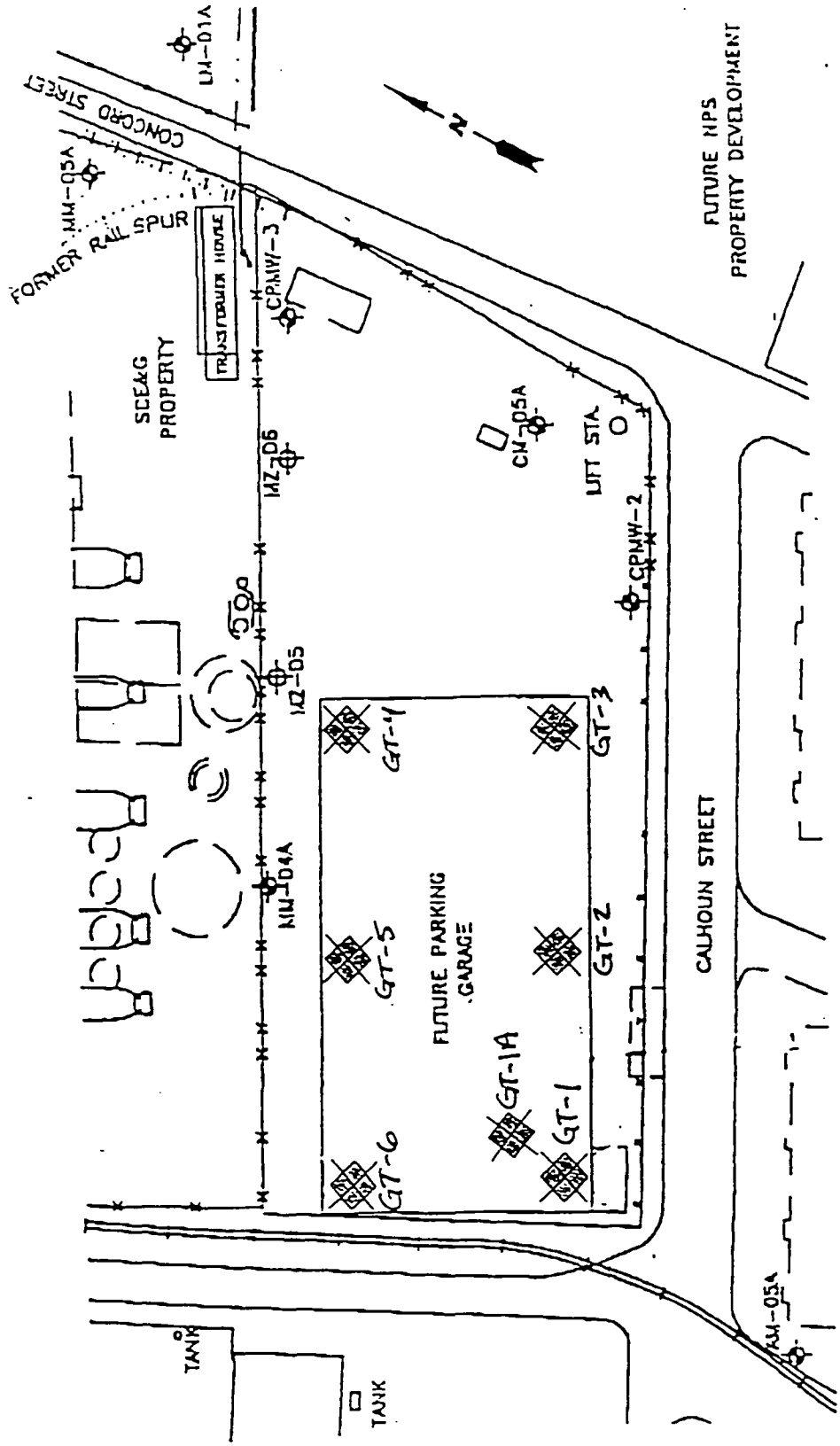
FIELD TESTING PROCEDURES

SOIL DATA SUMMARY

CONSOLIDATION REPORT

LABORATORY TESTING PROCEDURE

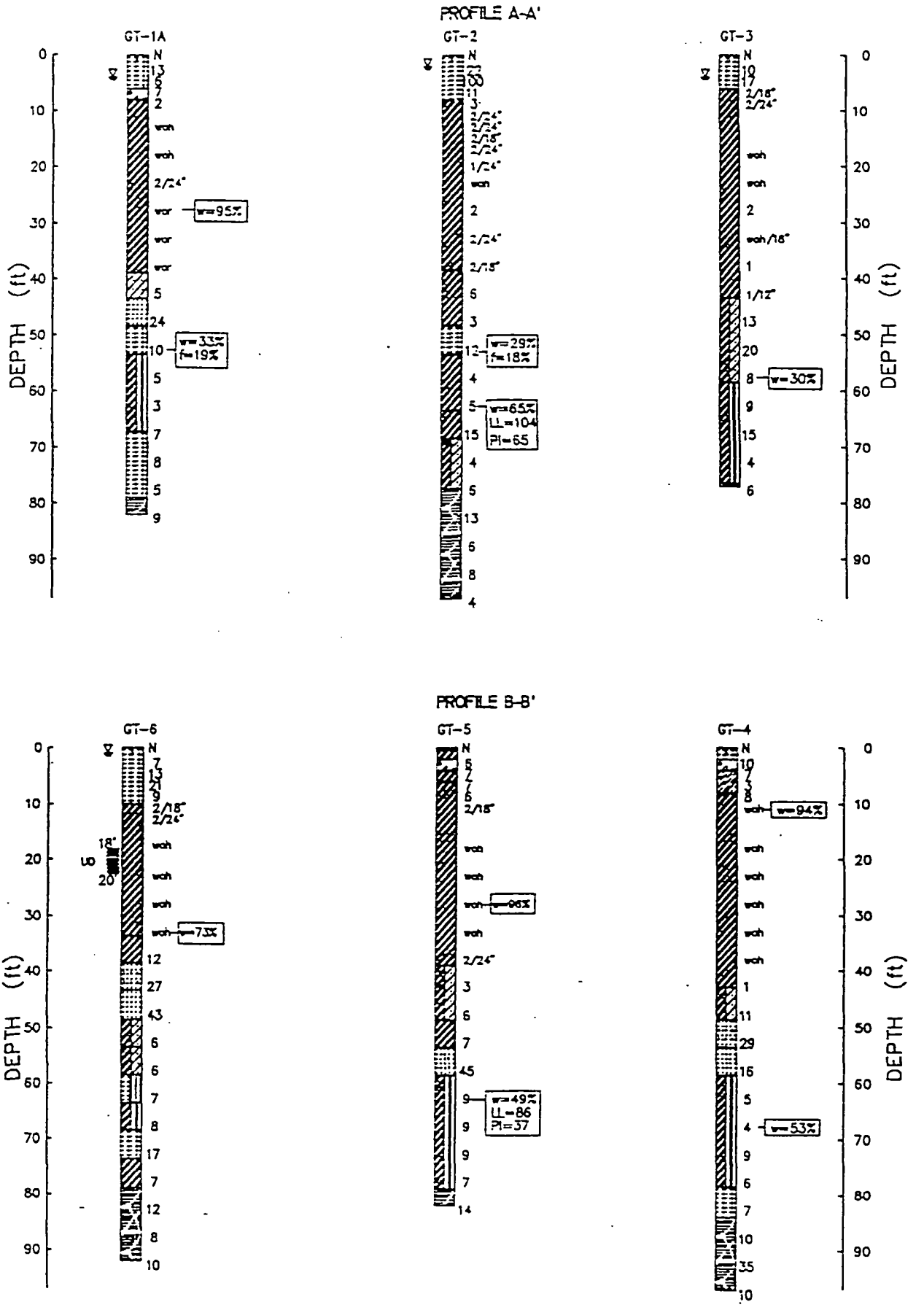
FIGURE A-3: SETTLEMENT PLATE DETAIL



Boring locations are shown in general arrangement only. Do not use boring locations for determination of distances or quantities. This plan is adapted from site plan provided by Fluor Daniel GTI, Inc.

Soil Test Boring

Job No : 1131-97-290	S&ME	Boring Location Plan Aquarium Parking Garage Charleston, South Carolina	Figure No: A-1
Date: September 17, 1997			
Not to Scale			



SCALE:	NTS
CHECKED BY:	
DRAWN BY:	KLE
DATE:	09-22-97

S&ME
ENVIRONMENTAL SERVICES
ENGINEERING · TESTING

SOIL PROFILES A-A' & B-B'
Aquarium Parking Garage
Charleston, South Carolina

JOB NO: 1131-97-290

FIGURE NO.
A-2

PROJECT: AQUARIUM PARKING GARAGE
CHARLESTON, SOUTH CAROLINA
1131-97-290

BORING LOG GT-1

DATE STARTED: 8/13/97 | DATE FINISHED: 8/13/97

NOTES: GUS-PECH 1000, AUTOMATIC SAFETY HAMMER. 12" BIT FROM 0' TO 10'.

DRILLING METHOD: MUD ROTARY

CASING LENGTH: | DRILLER: RICHARD SIMMONS

WATER LEVEL: WATER AT 4 FEET AT TIME OF DRILLING

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (ft-MSL)	SAMPLE NO/TYPE	STANDARD PENETRATION TEST DATA (blows/ft) 0 10 20 30 60 80	N VALUE
		FILL: SILTY SAND (SM)				
		medium dense, dark brown, fine		S-1		13
				S-2		17
5		- - - wood fragments				
		- - - brick fragments, odor		S-3		17
				S-4		27
		FILL: SANDY GRAVEL (SP/GP)				
10		medium dense, gray and reddish-brown, coarse; brick and wood content, odor		S-5		15
		FILL: CLAY WITH WOOD (CH/OH)		S-6		22
		very stiff, dark gray				
		BORING ABANDONED AT 12 FEET				

1. *BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.*
2. *PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.*

S & ME, INC.
840 LOW COUNTRY BOULEVARD
MT. PLEASANT, SOUTH CAROLINA

PROJECT: AQUARIUM PARKING GARAGE
CHARLESTON, SOUTH CAROLINA
1131-97-290

BORING LOG GT-1A

DATE STARTED: 8/13/97 | DATE FINISHED: 8/20/97

DRILLING METHOD: MUD ROTARY

CASING LENGTH: 8" & 4"/15' & 58' | DRILLER: RICHARD SIMMONS

WATER LEVEL: WATER AT 4 FEET AT TIME OF DRILLING

NOTES: GUS-PECH 1000, AUTOMATIC SAFETY HAMMER, 12" BIT FROM 0' TO 8', 4" BIT 8' TO 82'.

DEPTH (feet)	MATERIAL DESCRIPTION	ELEVATION (ft-MSL)	SAMPLE NO/TYPE	N VALUE
0	FILL: SILTY SAND (SM) medium dense, dark brown, fine		S-1	13
5	- - - loose; wood fragments		S-2	6
	- - - odor		S-3	7
	FILL: GRAVEL (GP) very loose, dark brown, coarse; clay lenses, slight odor		S-4	2
10	CLAY (CH) very soft, dark gray; trace shell & marsh grass		S-5	woh
15	- - -		S-6	woh
20	- - - slightly sandy, trace shell, marsh grass and wood content		S-7	2/24"
25	- - - no visible wood content, w = 95%		S-8	wor
30	- - - no visible marsh grass or shell content		S-9	wor
35	- - -		S-10	wor
40	CLAYEY SAND (SC) loose, bluish-gray, fine		S-11	5
45	SAND (SP) medium dense, gray, fine to medium		S-12	24
50	SILTY SAND (SM) loose, bluish-gray, fine; trace shell hash, w = 33%, fines = 19%		S-13	10
	SANDY CLAY (CH/MH)			

STANDARD PENETRATION TEST DATA (blows/ft) 0 10 20 30 60 80

1. *BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.*
2. *PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.*

S & ME, INC.
840 LOW COUNTRY BOULEVARD
MT. PLEASANT, SOUTH CAROLINA

PROJECT: AQUARIUM PARKING GARAGE
CHARLESTON, SOUTH CAROLINA
1131-97-290

BORING LOG GT-1A

DATE STARTED: 8/13/97 | DATE FINISHED: 8/20/97

NOTES: GUS-PECH 1000. AUTOMATIC SAFETY HAMMER. 12" BIT FROM 0' TO 8', 4" BIT 8' TO 82'.

DRILLING METHOD: MUD ROTARY

CASING LENGTH: 8" & 4"/15' & 58' | DRILLER: RICHARD SIMMONS

WATER LEVEL: WATER AT 4 FEET AT TIME OF DRILLING

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (ft-MSL)	SAMPLE NO/TYPE	STANDARD PENETRATION TEST DATA (blows/ft) 0 10 20 30 60 80	N VALUE
		firm, greenish-gray		S-14		5
60		- - - (CH), soft; slight sand and shell content, PP = 1.5		S-15		3
65		- - - no recovery		S-16		7
		SILTY SAND (SM) loose, dark bluish-gray, fine; trace shell hash		S-17		8
70						
75		- - -		S-18		5
80		COOPER GROUP: SANDY SILT (MH) stiff, olive; calcareous, PP = 1.25				
		BORING TERMINATED AT 82 FEET		S-19		9

1. *BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.*
2. *PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.*

S & ME, INC.
840 LOW COUNTRY BOULEVARD
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PROJECT: AQUARIUM PARKING GARAGE
CHARLESTON, SOUTH CAROLINA
1131-97-290

BORING LOG GT-2

DATE STARTED: 8/12/97 | DATE FINISHED: 8/19/97

DRILLING METHOD: MUD ROTARY

CASING LENGTH: 8" & 4"/19' & 62' | DRILLER: RICHARD SIMMONS

WATER LEVEL: WATER AT 2 FEET AT TIME OF DRILLING

NOTES: GUS-PECH 1000, AUTOMATIC SAFETY HAMMER, 12" BIT FROM 0' TO 19', 4" BIT 19' TO 97'.

DEPTH (feet)	MATERIAL DESCRIPTION	ELEVATION (ft-MSL)	SAMPLE NO/TYPE	N VALUE
0	FILL: SILTY SAND (SM) medium dense, brown, fine; root and brick content		S-1	22
5	- - - very dense; slight brick content, wood in shoe		S-2	50/6"
	- - - (SP-SM), medium dense, coarse; brick content		S-3	11
	- - - (SM), loose, fine		S-4	3
10	CLAY (CH) very soft, dark gray; slight sand & organic content		S-5	2/24"
	- - -		S-6	2/24"
15	- - -		S-7	2/18"
	- - -		S-8	2/24"
	- - -		S-9	1/24"
20	- - - some sand, trace shell hash		S-10	woh
25	- - - slight sand and marsh grass content		S-11	2
30	- - - no visible marsh grass		S-12	2/24"
35	- - -		S-13	2/18"
40	SANDY CLAY (CH) firm, dark gray; sand seams, H2S odor		S-14	6
45	- - - soft, gray and bluish-gray		S-15	3
50	SILTY SAND (SM) medium dense, dark gray, fine; w = 29%, fines = 18%		S-16	12
	CLAY (CH)			

STANDARD PENETRATION TEST DATA (blows/ft)
0 10 20 30 60 80

1. *BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.*
2. *PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.*

S & ME, INC.
840 LOW COUNTRY BOULEVARD
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PROJECT: AQUARIUM PARKING GARAGE
CHARLESTON, SOUTH CAROLINA
1131-97-290

BORING LOG GT-2

DATE STARTED: 8/12/97 | DATE FINISHED: 8/19/97

DRILLING METHOD: MUD ROTARY

CASING LENGTH: 8" & 4"/19' & 62' | DRILLER: RICHARD SIMMONS

WATER LEVEL: WATER AT 2 FEET AT TIME OF DRILLING

NOTES: GUS-PECH 1000, AUTOMATIC SAFETY HAMMER, 12" BIT FROM 0' TO 19', 4" BIT 19' TO 97'.

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (ft-MSL)	SAMPLE NO/TYPE	STANDARD PENETRATION TEST DATA (blows/ft) 0 10 20 30 60 80	N VALUE
		soft, bluish-gray; some sand		S-17		4
60				S-18		5
		- - - firm; slight sand, w = 65%, LL = 104, PI = 65				
65		CLAY (CH/GP) WITH SHELL stiff, dark bluish-gray		S-19		15
70		VERY CLAYEY SAND (SC/CH) very loose, dark bluish-gray, fine; silt content		S-20		4
75		- - -		S-21		6
80		COOPER GROUP: SANDY SILT (MH) stiff, olive; calcareous, PP = 1.75		S-22		13
85		- - - firm; PP = 1.25		S-23		6
90		- - - PP = 1.5		S-24		8
95		- - - soft; PP = 1.5		S-25		4
		BORING TERMINATED AT 97 FEET				

1. *BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.*
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S & ME, INC.
840 LOW COUNTRY BOULEVARD
MT. PLEASANT, SOUTH CAROLINA

PROJECT: AQUARIUM PARKING GARAGE
CHARLESTON, SOUTH CAROLINA
1131-97-290

BORING LOG GT-3

DATE STARTED: 8/13/97 | DATE FINISHED: 8/20/97

NOTES: GUS-PECH 1000, AUTOMATIC SAFETY HAMMER, 12" BIT FROM 0' TO 8', 4" BIT FROM 8' TO 77'.

DRILLING METHOD: MUD ROTARY

CASING LENGTH: 8" & 4"/15' & 62' | DRILLER: RICHARD SIMMONS

WATER LEVEL: WATER AT 4 FEET AT TIME OF DRILLING

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (ft-MSL)	SAMPLE NO/TYPE	STANDARD PENETRATION TEST DATA (blows/ft) 0 10 20 30 60 80	N VALUE
0		FILL: SILTY SAND (SM) loose, dark brown; root content		S-1		10
		- - - medium dense; slight gravel and root content		S-2		17
5		- - - (SP-SM), very loose, odor		S-3		2/18"
		CLAY (CH) very soft, dark gray		S-4		2/24"
10						
15		- - - very soft, dark gray; some sand		S-5		woh
20		- - - sandy		S-6		woh
25		- - - high shell content		S-7		2
30		- - - slightly sandy, no shell content		S-8		woh/1S
35		- - -		S-9		1
40		- - -		S-10		1/12"
45		VERY CLAYEY SAND (CH/SC) medium dense, bluish-gray; clay lenses		S-11		13
50		- - -		S-12		20

1. *BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.*
2. *PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.*

S & ME, INC.
840 LOW COUNTRY BOULEVARD
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PROJECT: AQUARIUM PARKING GARAGE
CHARLESTON, SOUTH CAROLINA
1131-97-290

BORING LOG GT-3

DATE STARTED: 8/13/97 | DATE FINISHED: 8/20/97

DRILLING METHOD: MUD ROTARY

CASING LENGTH: 8" & 4"/15' & 62' | DRILLER: RICHARD SIMMONS

WATER LEVEL: WATER AT 4 FEET AT TIME OF DRILLING

NOTES: GUS-PECH 1000, AUTOMATIC SAFETY HAMMER. 12" BIT FROM 0' TO 8', 4" BIT FROM 8' TO 77'.

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (ft-MSL)	SAMPLE NO/TYPE	STANDARD PENETRATION TEST DATA (blows/ft) 0 10 20 30 60 80	N VALUE
		- - - loose, fine to coarse; w = 30%		S-13		8
60		CLAY (CH/MH) stiff, greenish-gray; slight sand content		S-14		9
65		- - -		S-15		15
70		- - - soft; sandy, some shell content		S-16		4
75		- - - no visible shell hash				
		COOPER GROUP: SILTY SAND (SM) loose, olive, fine; calcareous		S-17		6
		BORING TERMINATED AT 77 FEET				

1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.
2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

S & ME, INC.
840 LOW COUNTRY BOULEVARD
MT. PLEASANT, SOUTH CAROLINA

PROJECT: AQUARIUM PARKING GARAGE
CHARLESTON, SOUTH CAROLINA
1131-97-290

BORING LOG GT-4

DATE STARTED: 8/14/97 | DATE FINISHED: 8/21/97

DRILLING METHOD: MUD ROTARY

CASING LENGTH: 8" & 4"/15' & 62' | DRILLER: RICHARD SIMMONS

WATER LEVEL: WATER AT 1.5 FEET AT TIME OF DRILLING

NOTES: GUS-PECH 1000, AUTOMATIC SAFETY HAMMER, 12" BIT FROM 0' TO 10', 4" BIT FROM 10' TO 97'.

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (ft-MSL)	SAMPLE NO/TYPE	STANDARD PENETRATION TEST DATA (blows/ft) 0 10 20 30 60 80	N VALUE
		FILL: SILTY SAND (SM) loose, dark brown, fine; organic content		S-1		10
		FILL: GRAVEL (GP) loose, dark black, fine to coarse; odor		S-2		7
5		FILL: ORGANICS AND WOOD FRAGMENTS (OH) soft, dark brown		S-3		3
		- - - stiff; slight gravel content		S-4		8
10		CLAY (CH) very soft, dark gray; slight sand and marsh grass content		S-5		woh
15		- - - no visible marsh grass, w = 94%		S-6		woh
20		- - - some sand		S-7		woh
25		- - - slight sand		S-8		woh
30		- - - slight sand and marsh grass		S-9		woh
35		- - -		S-10		woh
40		- - -		S-11		1
45		VERY SANDY CLAY (CH/SC) stiff, gray and greenish-gray; fine grained sand		S-12		11
50		SLIGHTLY SILTY SAND (SP-SM) dense, gray, fine; micaceous		S-13		29
		SAND (SP)				

1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.
2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

S & ME, INC.
840 LOW COUNTRY BOULEVARD
MT. PLEASANT, SOUTH CAROLINA

PROJECT: AQUARIUM PARKING GARAGE
CHARLESTON, SOUTH CAROLINA
1131-97-290

BORING LOG GT-4

DATE STARTED: 8/14/97 | DATE FINISHED: 8/21/97

DRILLING METHOD: MUD ROTARY

CASING LENGTH: 8" & 4"/15' & 62' | DRILLER: RICHARD SIMMONS

WATER LEVEL: WATER AT 1.5 FEET AT TIME OF DRILLING

NOTES: GUS-PECH 1000, AUTOMATIC SAFETY HAMMER. 12" BIT FROM 0' TO 10', 4" BIT FROM 10' TO 97'.

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (ft-MSL)	SAMPLE NO/TYPE	STANDARD PENETRATION TEST DATA (blows/ft) 0 10 20 30 60 80	N VALUE
		medium dense, gray, medium to coarse; trace phosphate nodules		S-14		16
60		CLAY (CH/MH) firm, greenish-gray; some sand content, slight shell content		S-15		5
65		- - - soft; some shell content, w = 53%		S-16		4
70		- - - stiff; slight sand content, no visible shell content		S-17		9
75		- - - firm		S-18		6
80		SILTY SAND (SM) loose, dark bluish-gray, fine; slight clay content		S-19		7
85		COOPER GROUP: SANDY SILT (MH) stiff, olive; calcareous		S-20		10
90		- - - hard; sand seams, PP = 3.0		S-21		35
95		- - - stiff; no sand seams BORING TERMINATED AT 97 FEET		S-22		10

1. *BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.*
2. *PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.*

S & ME, INC.
840 LOW COUNTRY BOULEVARD
MT. PLEASANT, SOUTH CAROLINA

PROJECT: AQUARIUM PARKING GARAGE
CHARLESTON, SOUTH CAROLINA
1131-97-290

BORING LOG GT-5

DATE STARTED: 8/14/97 | DATE FINISHED: 8/21/97

NOTES: GUS-PECH 1000, AUTOMATIC SAFETY HAMMER, 12" BIT FROM 0' TO 10', 4" BIT FROM 10' TO 82'.

DRILLING METHOD: MUD ROTARY

CASING LENGTH: 8" & 4"/15' & 63' | DRILLER: RICHARD SIMMONS

WATER LEVEL: WATER AT 2 FEET AT TIME OF DRILLING

DEPTH (feet)	MATERIAL DESCRIPTION	ELEVATION (ft-MSL)	SAMPLE NO/TYPE	STANDARD PENETRATION TEST DATA (blows/ft) 0 10 20 30 60 80	N VALUE
0	FILL: SANDY CLAY (CH) firm, yellowish-brown, gray and brown; slight root content		S-1		6
			S-2		7
5	FILL: CLAYEY GRAVEL (GP) loose, black, fine to medium; slight organic content, strong odor		S-3		7
	FILL: SANDY CLAY (CH) firm, dark gray and gray; brick content		S-4		6
10	CLAY (CH) firm, dark gray; slight sand, brick, shell and wood content		S-5		2/18"
	- - - very soft; slight sand and wood content				
15	- - - some sand and shell hash		S-6		woh
20	- - -		S-7		woh
25	- - - slight sand content, w = 96%		S-8		woh
30	- - -		S-9		woh
35	- - -		S-10		2/24"
40	VERY CLAYEY SAND (SC/CH) very loose, dark bluish-gray, fine		S-11		3
45	- - - loose		S-12		6
50	CLAY (CH) firm, dark greenish-gray; slight fine sand content		S-13		7
	SAND (SP/SP-SM)				

1. *BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.*
2. *PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.*

S & ME, INC.
840 LOW COUNTRY BOULEVARD
MT. PLEASANT, SOUTH CAROLINA

PROJECT: AQUARIUM PARKING GARAGE
CHARLESTON, SOUTH CAROLINA
1131-97-290

BORING LOG GT-5

DATE STARTED: 8/14/97 | DATE FINISHED: 8/21/97

DRILLING METHOD: MUD ROTARY

CASING LENGTH: 8" & 4"/15' & 63' | DRILLER: RICHARD SIMMONS

WATER LEVEL: WATER AT 2 FEET AT TIME OF DRILLING

NOTES: GUS-PECH 1000, AUTOMATIC SAFETY HAMMER, 12" BIT FROM 0' TO 10', 4" BIT FROM 10' TO 82'.

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (ft-MSL)	SAMPLE NO/TYPE	STANDARD PENETRATION TEST DATA (blows/ft) 0 10 20 30 60 80	N VALUE
		dense, gray, medium to coarse; trace phosphate nodules		S-14		45
60		CLAY (CH/MH) stiff, greenish-gray; slight sand and shell hash, w = 49%, LL = 86, PI = 37		S-15		9
65		- - - (CH/SC), very sandy		S-16		9
70		- - -		S-17		9
75		- - - firm		S-18		7
80		COOPER GROUP: VERY SILTY SAND (MH/SM) medium dense, olive, fine; calcareous		S-19		14
		BORING TERMINATED AT 82 FEET				

1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.
2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

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PROJECT: AQUARIUM PARKING GARAGE
CHARLESTON, SOUTH CAROLINA
1131-97-290

BORING LOG GT-6

DATE STARTED: 8/13/97 | DATE FINISHED: 8/20/97

NOTES: GUS-PECH 1000, AUTOMATIC SAFETY HAMMER. 12" BIT FROM 0' TO 12', 4" BIT FROM 15' TO 92'.

DRILLING METHOD: MUD ROTARY

CASING LENGTH: 12" & 4"/15' & 57' | DRILLER: RICHARD SIMMONS

WATER LEVEL: WATER AT 2 FEET AT TIME OF DRILLING

DEPTH (feet)	MATERIAL DESCRIPTION	ELEVATION (ft-MSL)	SAMPLE NO/TYPE	N VALUE
	FILL: SILTY SAND (SM)			
	loose, dark brown, fine; root content, odor		S-1	7
	- - - medium dense		S-2	13
5	- - -		S-3	21
	- - - loose; clay lenses, brick and gravel content, slight odor		S-4	9
	- - - No Recovery		S-5	2/18"
10	CLAY (CH)		S-6	2/24"
	very soft, dark gray; slight shell content			
15	- - - slight sand and shell content		S-7 UD	woh
	3" x 30" Shelby Tube Pushed 18' to 20', 24" Recovery, w = 126%, fines = 94%, LL = 147, PI = 107		S-8	woh
20	- - - slight sand and marsh grass content			
25	- - -		S-9	woh
30	- - - w = 73%		S-10	woh
35	CLAY (CH)		S-11	12
	stiff, bluish-gray; slight sand content, PP = 1.5			
40	SLIGHTLY SILTY SAND (SP-SM)		S-12	27
	medium dense, gray and bluish-gray, fine; clay lenses			
45	SAND (SP)		S-13	43
	dense, gray, medium to coarse; trace phosphate nodules			
50	VERY CLAYEY SAND (SC/CH)		S-14	6
	loose, greenish-gray, fine; trace shell content			
	VERY SANDY CLAY (CH/SC)			

STANDARD PENETRATION TEST DATA (blows/ft)
0 10 20 30 60 80

1. *BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.*
2. *PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.*

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PROJECT: AQUARIUM PARKING GARAGE
CHARLESTON, SOUTH CAROLINA
1131-97-290

BORING LOG GT-6

DATE STARTED: 8/13/97 | DATE FINISHED: 8/20/97

DRILLING METHOD: MUD ROTARY

CASING LENGTH: 12" & 4"/15' & 57' | DRILLER: RICHARD SIMMONS

WATER LEVEL: WATER AT 2 FEET AT TIME OF DRILLING

NOTES: GUS-PECH 1000, AUTOMATIC SAFETY HAMMER, 12" BIT FROM 0' TO 12', 4" BIT FROM 15' TO 92'.

DEPTH (feet)	MATERIAL DESCRIPTION	ELEVATION (ft-MSL)	SAMPLE NO/TYPE	N VALUE
	firm, greenish-gray; slight shell content, PP = 1.5		S-15	6
60	VERY SILTY SAND (SM/MH) loose, dark gray, fine; some clay content, slight shell hash		S-16	7
65	SANDY CLAY (CH/MH) firm, dark bluish-gray; PP = 1.0		S-17	8
70	SILTY SAND (SM) medium dense, dark bluish-gray, fine; slight clay content		S-18	17
75	CLAY (CH) firm, dark bluish-gray; slight sand content, sand lenses, PP = 1.0		S-19	7
80	COOPER GROUP: SANDY SILT (MH) stiff, olive; calcareous, PP = 1.75		S-20	12
85	- - - firm; PP = 1.25		S-21	8
90	- - - stiff; PP = 1.25		S-22	10
	BORING TERMINATED AT 92 FEET			

STANDARD PENETRATION TEST DATA (blows/ft)
0 10 20 30 60 80

1. *BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.*
2. *PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.*

S & ME, INC.
840 LOW COUNTRY BOULEVARD
MT. PLEASANT, SOUTH CAROLINA

FIELD TESTING PROCEDURES

Soil Classifications

Soil classifications provide a general guide to the engineering properties of various soil types and enable the engineer to apply his past experience to current problems. In our exploration, samples obtained during drilling operations are examined and visually classified according to color, texture, and relative density or consistency (based on standard penetration resistance). The consistency and relative density designations are as follows:

SANDS		SILTS AND CLAYS	
N(SPT)	Relative Density	N(SPT)	Consistency
0 - 4	Very Loose	0 - 2	Very Soft
5 - 10	Loose	3 - 4	Soft
11 - 30	Medium Dense	5 - 8	Firm
		9 - 15	Stiff
31 - 50	Dense	16 - 30	Very Stiff
50÷	Very Dense	31 - 50	Hard
		50÷	Very Hard

Soil Test Borings

All boring and sampling operations were conducted in accordance with ASTM Designation D-1586. Initially, the borings were advanced by either mechanically augering or wash boring through the soils. Where necessary, a heavy drilling fluid is used below the water table to stabilize the side and bottom of the drill hole. At regular intervals soil samples were obtained with a standard 1.4-inch I.D., 2-inch O.D., split-barrel sampler. The sampler was first seated 6 inches to penetrate any loose cuttings and then driven an additional foot with blows of a 140 pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot is designated the "Standard Penetration Resistance". The penetration resistance, when properly evaluated, is an index to the soil strength.

Undisturbed Sampling

The split-barrel samples obtained during the penetration testing are available for visual examination and routine classification tests, but are not sufficiently intact for more quantitative laboratory testing. Consequently, undisturbed samples were obtained by forcing 30-inch long, 3-inch O.D. thin walled steel tube into the soil at the desired sampling level. This sampling procedure is described by ASTM Specification D-1587. After removing the sampler from the borehole, the ends are scraped to remove loose soils and sealed with microcrystalline wax. The undisturbed samples were then returned to the laboratory for testing.

September 15, 1997

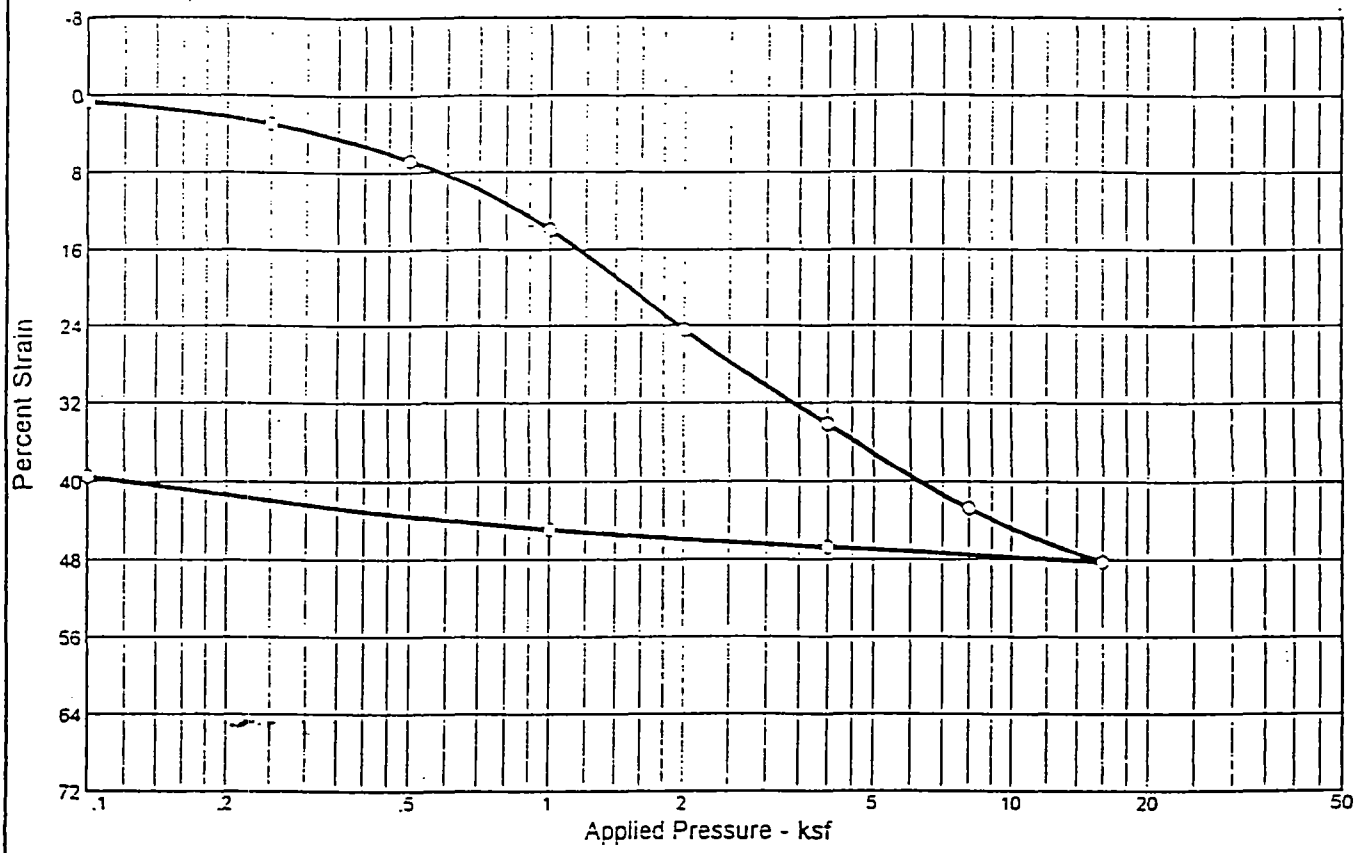
SOIL DATA SUMMARY

Aquarium Parking Garage

Job No. 1131-97-290

BORING NUMBER	SAMPLE DEPTH (Feet)	CLASSIFICATION	STANDARD PENETRATION RESISTANCE	NATURAL MOISTURE (%)	% FINER # 200	UNIT WEIGHT P.C.F.		MODIFIED PROCTOR DATA		SPECIFIC GRAVITY	VOID RATIO - E	UNCONFINED COMP. MAX.	ATTERBERG LIMIT		TRIAXIAL SHEAR		CONSOLIDATION Cc	OTHER
						W	D	MAX	OMC				LL	PI	C	O		
GT-1A	25 - 27	CH	wor	95														
	50 - 52	SM	10	33	19													
GT-2	50 - 52	SM	12	29	18													
	60 - 62	CH	5	65									104	65				
GT-3	55 - 57	CH/SC	8	30														
GT-4	15 - 17	CH	woh	94														
	65 - 67	CH	4	53														
GT-5	25 - 27	CH	woh	96														
	60 - 62	CH	9	49									86	57				
GT-6	18 - 20	CH	ud	126	94	116	51				2.26		147	107				
	30 - 32	CH	woh	73														

CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation

No.	Load (ksf)	C_v (ft.2/day)	C_α	No.	Load (ksf)	C_v (ft.2/day)	C_α	No.	Load (ksf)	C_v (ft.2/day)	C_α
1	0.10	0.01	0.002	11	0.10	0.00					
2	0.25	0.05	0.006								
3	0.50	0.02	0.011								
4	1.00	0.01	0.022								
5	2.00	0.01	0.029								
6	4.00	0.01	0.021								
7	8.00	0.01	0.020								
8	16.00	0.01	0.035								
9	4.00	0.06									
10	1.00	0.01									

Natural Sat.	Natural Moist.	Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (ksf)	P_c (ksf)	C_c	C_r	Swell Press. (ksf)	Swell %	e_o
149.3 %	125.9 %	51.3	147.1	106.5	2.68		0.66	1.08				2.261

MATERIAL DESCRIPTION	USCS	AASHTO

Project No. 1131-97-290 Client:

Project: Aquarium Parking Garage

Source: Boring GT-6 Sample No.: 1 Elev./Depth: 18 ft. to 20 f.

Remarks:

94.1% Passing #200 Sieve

CONSOLIDATION TEST REPORT

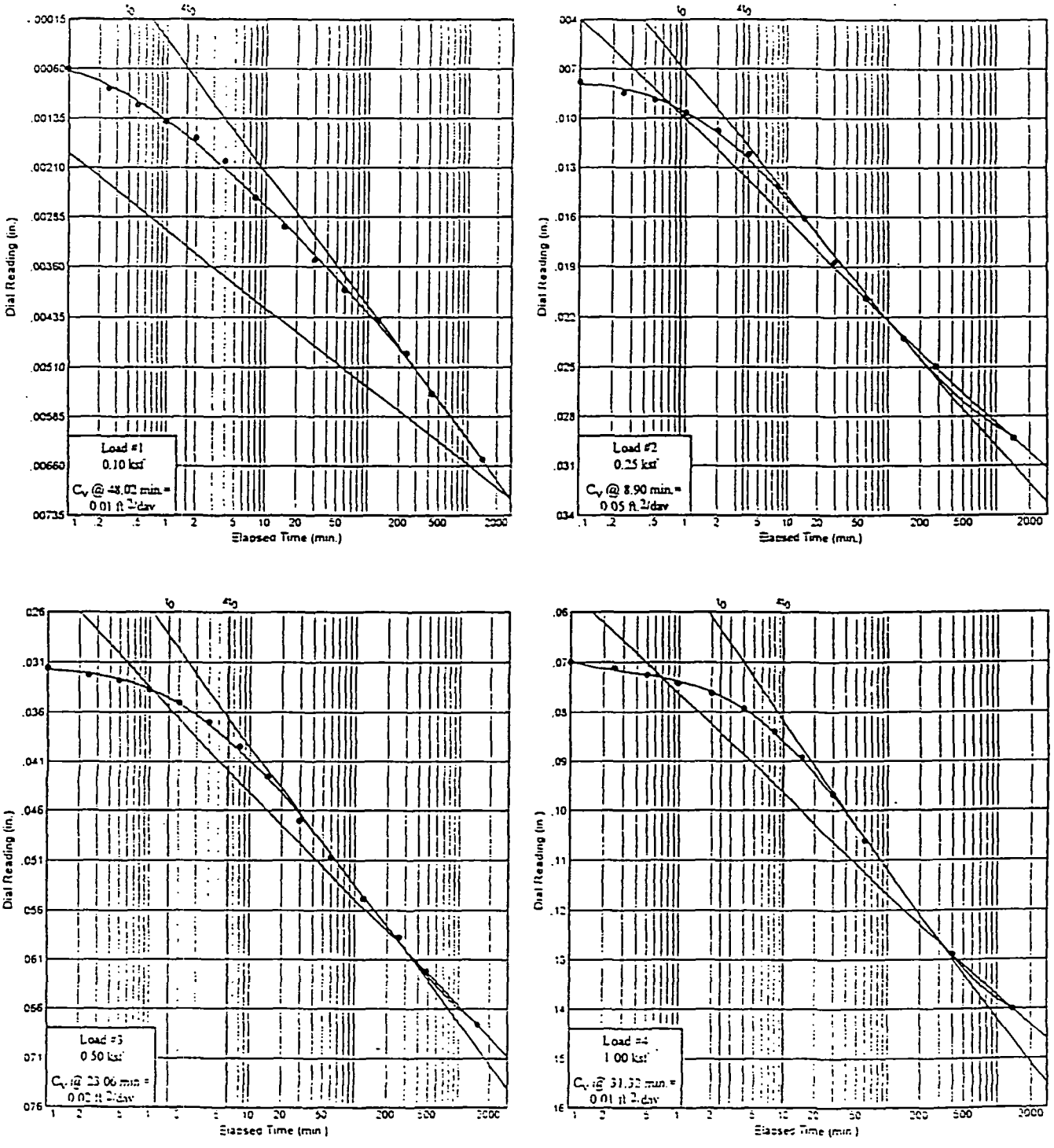
S & ME, Inc.

Figure 1

Dial Reading vs. Time

Project No.: 1131-97-290
Project: Aquarium Parking Garage

Source: Boring GT-6 Sample No.: 1 Elev./Depth: 18 ft. to 20 f.



Dial Reading vs. Time

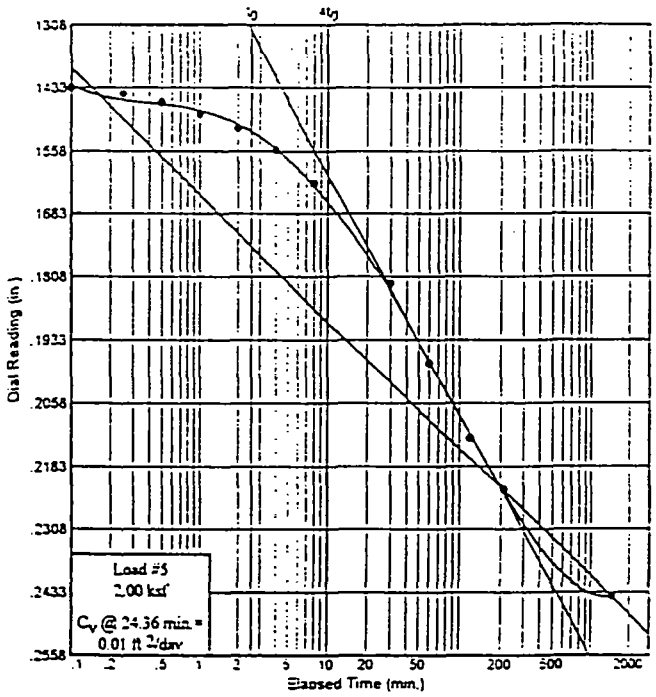
S & ME, Inc.

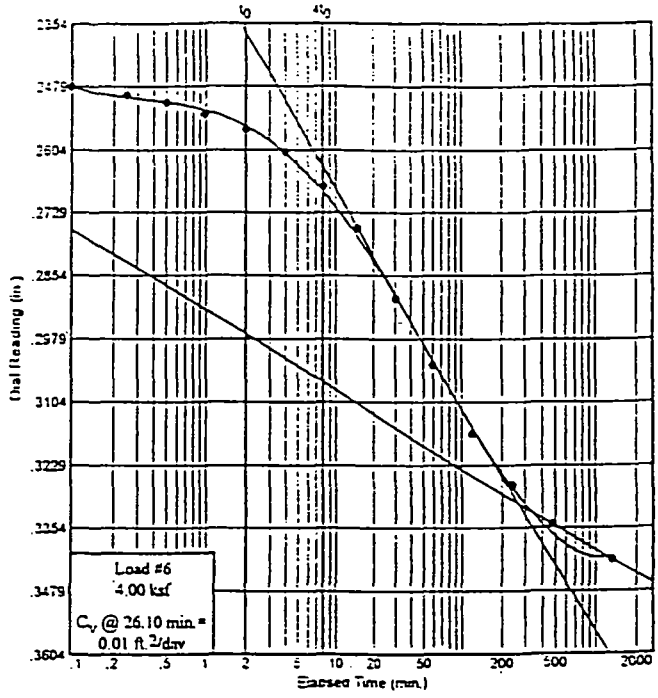
Figure 2

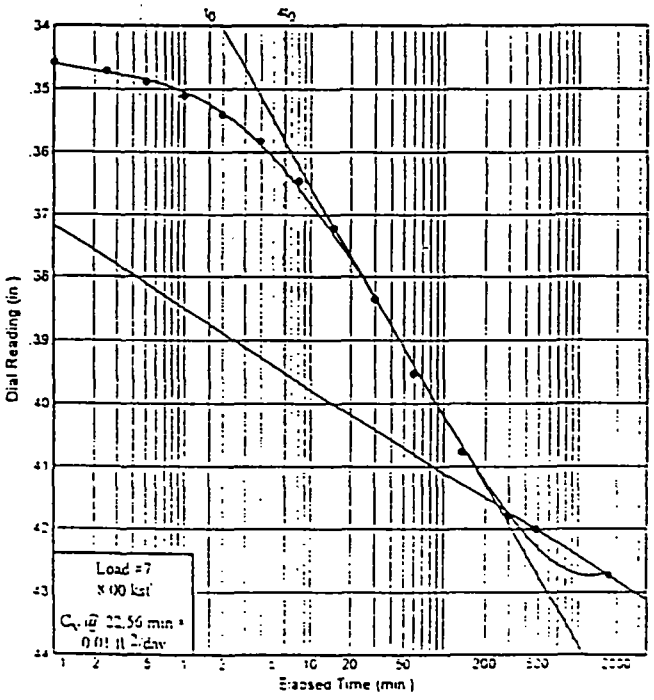
Dial Reading vs. Time

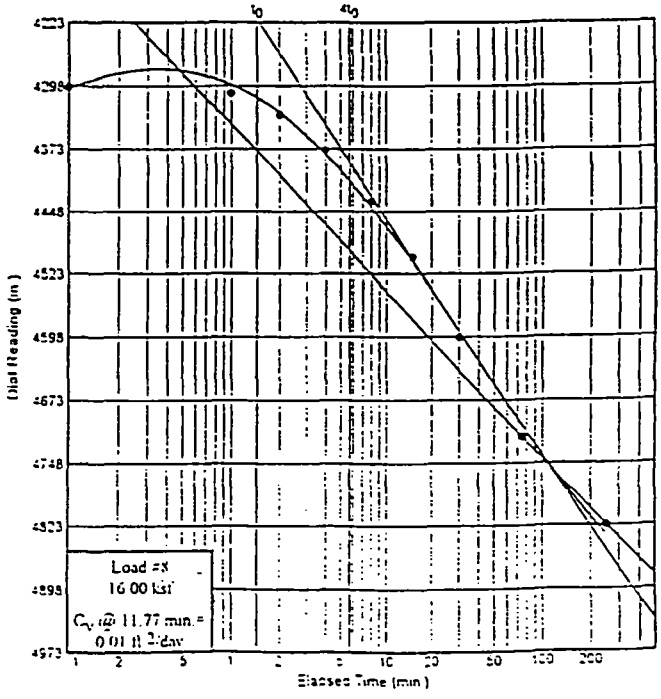
Project No.: 1131-97-290
Project: Aquarium Parking Garage

Source: Boring GT-6 Sample No.: 1 Elev./Depth: 18 ft. to 20 f.









Dial Reading vs. Time

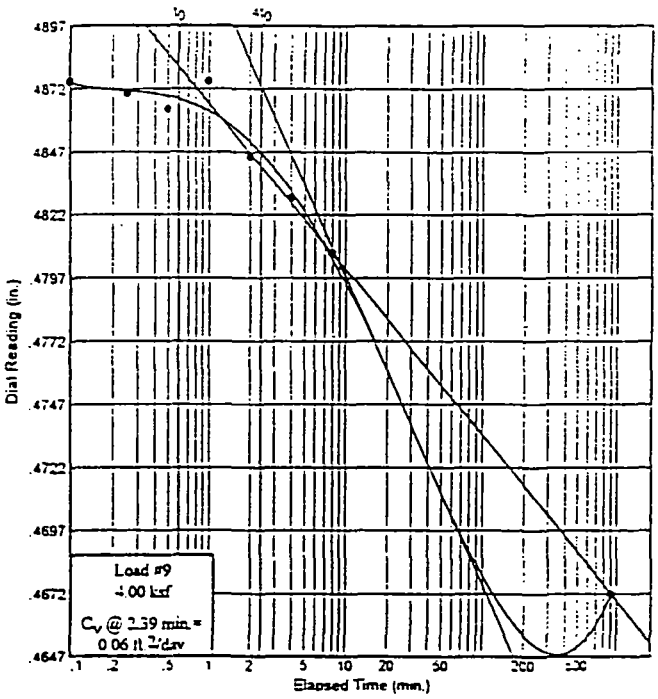
S & ME, Inc.

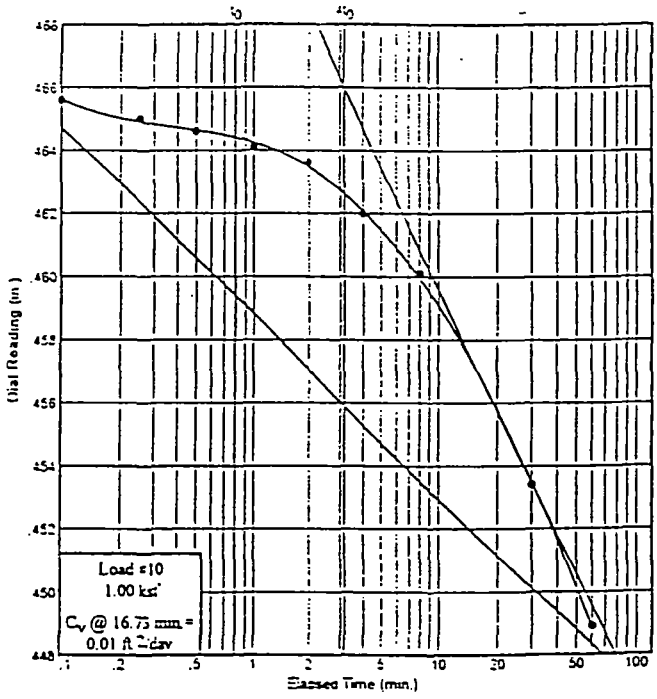
Figure 3

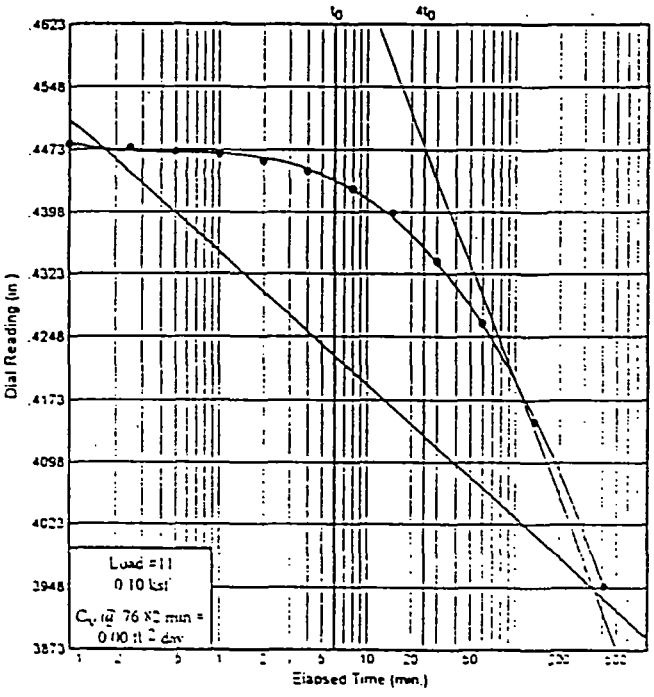
Dial Reading vs. Time

Project No.: 1131-97-290
Project: Aquarium Parking Garage

Source: Boring GT-6 Sample No.: 1 Elev./Depth: 18 ft. to 20 f.







Dial Reading vs. Time

S & ME, Inc.

Figure 4

CONSOLIDATION TEST DATA

Client:
Project: Aquarium Parking Garage
Project Number: 1131-97-290

Sample Data

Source: Boring GT-6
Sample No.: 1
Elev. or Depth: 18 ft. to 20 f. Sample Length (in./cm.): 1
Location:
Description:
Liquid Limit: 147.1 Plasticity Index: 106.5
USCS: AASHTO: Figure No.: 1
Testing Remarks: 94.1% Passing #200 Sieve

Test Specimen Data

TOTAL SAMPLE		BEFORE TEST	AFTER TEST	
Wet w+t	= 30.50 g.	Consolidometer # = 1	Wet w+t	= 188.16 g.
Dry w+t	= 13.50 g.		Dry w+t	= 155.68 g.
Tare Wt.	= .00 g.	Spec. Gravity = 2.68	Tare Wt.	= 109.75 g.
Height	= 1.00 in.	Height = 1.00 in.		
Diameter	= 2.50 in.	Diameter = 2.50 in.		
Weight	= 149.35 g.	Defl. Table = n/a		
Moisture	= 125.9 %	Ht. Solids = 0.3066 in.	Moisture	= 70.7 %
Wet Den.	= 115.9 pcf	Dry Wt. = 66.11 g.*	Dry Wt.	= 45.93 g.
Dry Den.	= 51.3 pcf	Void Ratio = 2.261	Void Ratio	= 0.973
		Saturation = 149.3 %		

* Initial dry weight used in calculations

End-of-Load Summary

Pressure (ksf)	Final Dial (in.)	Machine Defl. (in.)	C_v ($ft.^2$/day)	C_α	Void Ratio	% Compression /Swell
start	0.00000				2.261	
0.10	0.00650	0.00000	0.01	0.002	2.240	0.7 Comprs.
0.25	0.02935	0.00000	0.05	0.006	2.165	2.9 Comprs.
0.50	0.06760	0.00000	0.02	0.011	2.041	6.8 Comprs.
1.00	0.14000	0.00000	0.01	0.022	1.805	14.0 Comprs.
2.00	0.24410	0.00000	0.01	0.029	1.465	24.4 Comprs.
4.00	0.34170	0.00000	0.01	0.021	1.147	34.2 Comprs.
8.00	0.42730	0.00000	0.01	0.020	0.868	42.7 Comprs.
16.00	0.48220	0.00000	0.01	0.035	0.689	48.2 Comprs.
4.00	0.46720	0.00000	0.06		0.738	46.7 Comprs.
1.00	0.44890	0.00000	0.01		0.797	44.9 Comprs.
0.10	0.39490	0.00000	0.00		0.973	39.5 Comprs.

C_c = 1.08 P_c = 0.66 ksf

LABORATORY TESTING PROCEDURES

Moisture-Density Relationship (Modified Proctor) (ASTM D-1557)

Bulk samples of near surface soils were tested to determine moisture-density characteristics by the "modified" method using a 10-lb. hammer and 18 inch drop. The tests determine maximum dry density and optimum moisture content. Test results are graphically presented in the form of dry density versus moisture content on the Compaction Test sheets included in the Appendix.

Laboratory California Bearing Ratio (CBR) Tests (ASTM D-1883)

The California Bearing Ratio, usually abbreviated as CBR, is a punching shear test. The CBR value is a semi-empirical index of the soil strength and deflection characteristics and has been correlated with pavement performance to establish design curves for pavement thickness. The test was performed on 6-inch diameter, 5-inch thick discs of compacted soil, confined in a steel cylinder. The specimens were then soaked for 72 hours prior to testing. A piston approximately 2-inches in diameter was then forced into the soils at a standard rate to determine the resistance to penetration. The CBR is the ratio, expressed as a percentage, of the actual load required to produce a 0.1 inch deflection to the load required for the same deflection in a standard crushed stone sample. The results of the CBR tests are given on the CBR Test sheets included in the Appendix.

Grain Size Tests (ASTM D-1140 and ASTM D-422)

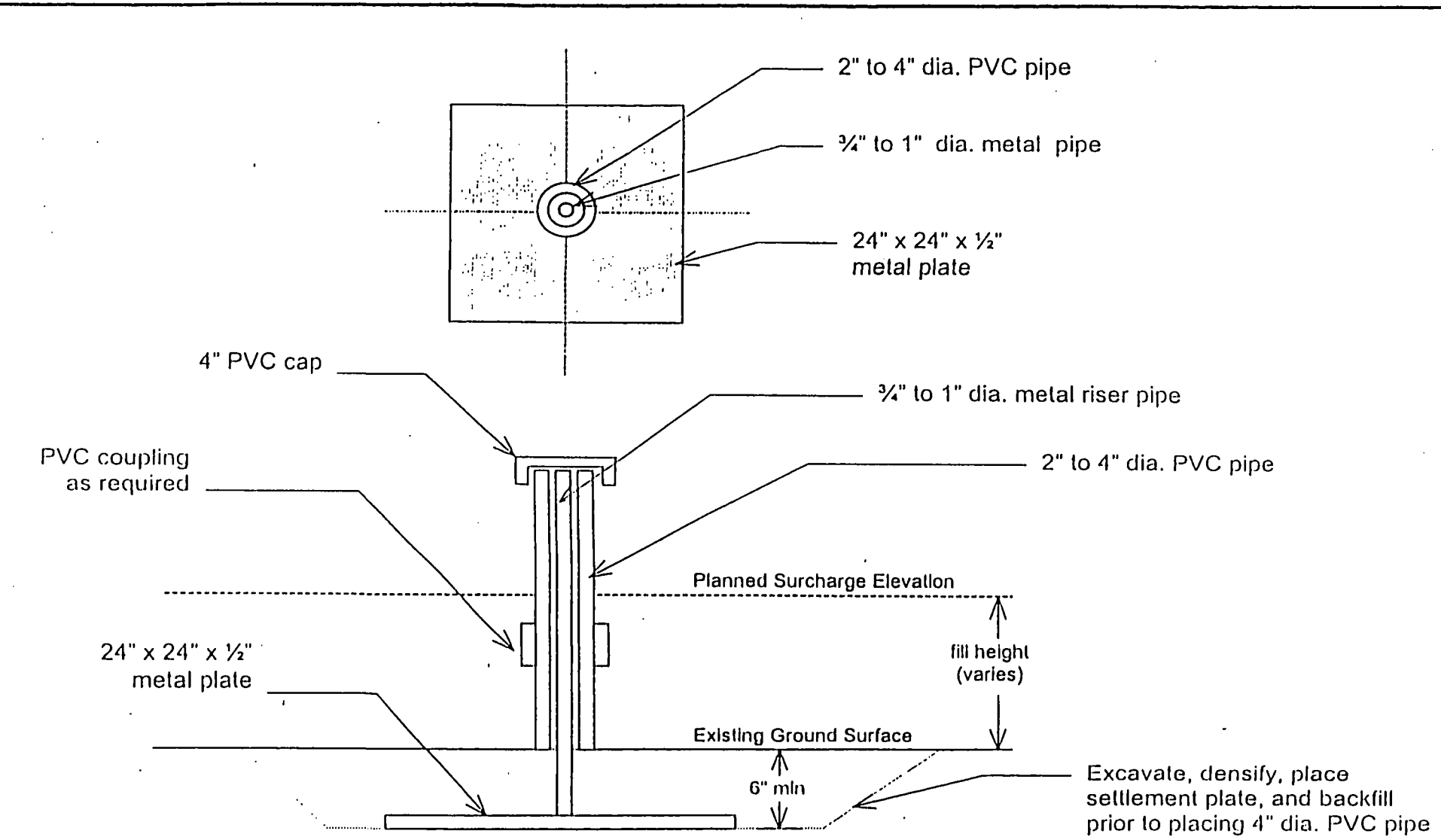
Grain size tests were performed to determine the soil particle size distribution. The amount of material finer than the #200 sieve was determined by washing the sample over that particular size sieve. The grain size distribution of the soil retained on the #200 sieve was then determined by passing the retained portion through a standard set of nested sieves.

Atterberg Limits Test (ASTM D-4318)

Atterberg Limits tests were performed to determine the soil plasticity characteristics. The soil plasticity index (PI) is representative of this characteristic and is bracketed by the liquid limit (LL) and the plastic limit (PL). The liquid limit is the moisture content at which the soil will flow as a heavy viscous fluid. The plastic limit is the moisture content at which the soil begins to lose its plasticity. The difference between the liquid limit and plastic limit is the plasticity index.

Moisture Content Test (ASTM D-2216)

Moisture content tests were conducted to determine the ratio, expressed as a percentage, of the weight of water in a given amount of soil to the weight of the solid particles.



Job No : 1131-97-290 Date: 19 September 1997 Scale: N.T.S.	S&ME	**Settlement Plate Detail** Aquarium Parking Garage Charleston, SouthCarolina	Figure No : A-3